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SPECTROSCOPIC OBSERVATIONS OF THE SUN.

BY J. NORMAN LOCKYER.*

No. IV.

I BEG to lay before the Royal Society, very briefly, the results of observations made on the 11th inst. in the neighbourhood of a fine spot, situated not very far from the sun's limb.

I. Under certain conditions the C and F lines may be observed *bright on the sun*, and in the spot spectrum also, as in prominences or in the chromosphere.

II. Under certain conditions, although they are not observed as bright lines, the corresponding Fraunhofer lines are blotted out.

III. The accompanying changes of refrangibility of the lines in question show that the absorbing material moves upwards and downwards as regards the radiating material, and that these motions may be determined with considerable accuracy.

IV. The bright lines observable in the ordinary spectrum are sometimes interrupted by the spot spectrum, i. e. they are only visible in those parts of the solar spectrum near, and away from, spots.

V. The C and F lines vary excessively in thickness over and near a spot, and on the 11th in the deeper portion of the spot they were much thicker than usual.

VI. Stars, in the spectrum of which the absorption lines of hydrogen are absent, may either have their chromospheric light radiated from beyond the limb just balanced by the light absorbed by the chromosphere on the disk, or they may come under the condition referred to in II., either absolutely or on the average.

ON THE COMPOSITION OF THE MILK OF THE SOW.

BY PROFESSOR CHARLES A. CAMERON, PH.D., M.D., ANALYST TO THE CITY OF DUBLIN.

WITH the exception of the milk of the sow, the lacteal secretions of the domesticated animals have been repeatedly analysed. Scheven appears to have been the only chemist who has published an analysis of sow's milk; but his results are so different from those of an analysis of sow's milk made by myself that I am induced to publish my analysis. In the sow's milk examined by me there was 6 per cent of fat, whilst in a specimen analysed by Scheven, the proportion of that constituent was under 2 per cent. It is not very easy to procure a specimen of sow's milk, and perhaps this is the reason why it has not hitherto been frequently analysed. I endeavoured on several occasions to obtain a small quantity, but the sows appealed to at my instigation were obdurate—they would not yield a drop, even when subjected to the dexterous manipulation of the most skilful dairymaids. At length, about two months ago, a specimen of sow's milk came into my possession; I am indebted for it to Thomas Baldwin, Esq., the Superintendent of Irish Agricultural Schools, and Director of the Glasnevin Government Model Farm. On submitting it to analysis, the following results were obtained:—Specific gravity, 1·041; colour, white, without any bluish shade; flavour very rich, resembling that of the skimmings of cow's milk; reaction, very faint alkaline. 100 parts contained:—

Water	81·80
Fats	6·00
Casein and other nitrogenous matters,	5·30
Lactin	6·07
Mineral Matter	0·83
	100·00
Total solids	18·20

The analysis was conducted as follows:—

a. A weighed portion of the milk was acidulated with a little acetic acid to prevent the formation of a skin, mixed with pulverised quartz (which had been previously boiled in hydrochloric acid, washed, and ignited), and evaporated in the water-bath to dryness.

b. The residue was treated with strong ether, by which the fats were dissolved. The ether was then evaporated and the residue of fats weighed. The fats were finally burned in a platinum capsule, and left no residue, proving the absence of mineral matter or casein.

c. The substance from which the fats had been removed was subjected to a nitrogen combustion, and from the amount of nitrogen obtained the proportion of casein and other nitrogenous substances present in the milk was estimated in the usual manner.

d. The proportion of lactin was found by difference, and also by the sulphate of copper method.

e. Determination of the mineral matter (ash). Five grammes of the milk were evaporated to dryness and the residue burned in oxygen gas. The amount of solid matter obtained by desiccating a weighed quantity of milk was slightly in excess of the sum of the weights of the individual constituents. It must, however, be borne in mind that the mineral matter in the nitrogenous substances is weighed twice—first, as a constituent of the casein, and, secondly, as an ingredient of the ash. Its amount, however, is trifling.

A comparison of the milk of the sow with that of the cow and other animals will show how extremely rich is the former.

Composition of the Milk of different Animals.

1,000 parts contain:—

	Water.	Butter.	Cheesy Matter.	Sugar.	Mineral Matter.
Woman	889·08	26·66	39·30	43·68	1·30
Cow	864·20	31·30	48·80	47·70	6·00
Goat	844·90	56·87	35·14	36·91	6·18
Ewe	832·32	51·31	69·78	39·43	7·16
Mare	904·30	24·36	33·35	32·76	5·23
Ass	890·12	18·53	35·65	50·46	5·24
Sow	818·00	60·00	53·00	68·70	8·30

* Read before the Royal Society, April 28th, 1869.

[English Edition, Vol. XIX., No. 492, page 217.]

Proportions of Solids and Water in different kinds of Milk.

	Woman.	Cow.	Goat.	Ewe.	Mare.	Ass.	Sow.
Water	889·08	864·20	844·90	832·32	904·30	890·12	818·00
Solids	110·92	135·80	155·10	167·68	95·70	109·88	182·00
	1000·00	1000·00	1000·00	1000·00	1000·00	1000·00	1000·00

The following particulars relative to the sow whose milk I have described were furnished to me by Mr. Baldwin:—"The sow whose milk I sent you is a pure Berkshire; she had pigged six days before the milk was withdrawn; she has a fair litter, and is an average nurse. She is receiving the sort of diet suited to her condition—viz., a mixture of small and damaged potatoes, pulped roots, and a little grains, the potatoes and roots being subjected to the action of steam. The food is not too rich, but just sufficient to keep herself and her young in a good healthy condition."

Pig's milk is extremely rich, containing, as it does, nearly 50 per cent more nutritive matter than is found in that of the cow. It is not unlikely that in certain forms of disease where a milk diet is prescribed the use of so concentrated a liquid food might prove serviceable.

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ON SOME APPLICATIONS OF ELECTRICITY TO NAVAL AND MILITARY PURPOSES.*

BY F. A. ABEL, F.R.S., FOR. SEC. C.S.

THE applications which electric science has received within the last few years in connection with the military and naval services are various and important. The employment of the electric light for signalling and reconnoitring purposes; the permanent establishment of telegraphic equipments by which an army in the field or at a siege is maintained in the most intimate communication with the directing powers; the employment of the electric signalling arrangements in ships of war, and the accurate investigation of the ballistic force of gunpowder and other explosive agents, are among the uses to which electricity has been put in connection with war purposes; but the earliest application, and one of the most important and extensive—one, moreover, possessing great interest from industrial points of view—is the employment of electricity as an agent for exploding land and submarine mines.

The possibility of applying the electric spark to the ignition of charges of gunpowder suggested itself both to Franklin, in 1751, and to Priestley in 1767; but it was not until some years after the discovery of the electric pile by Volta, that serious attempts were made to apply electricity to mining and military purposes. The first practical application of the voltaic battery in this direction was made little more than thirty years ago by French military Engineers; a few years afterwards that agent was successfully applied in this country in connection with important blasting operations, such as the destruction of Round Down Cliff at Dover, and the removal of the wrecks of the *Royal George* and *Edgar* at Spithead. The general method of operation then pursued was adhered to by military Engineers in this country until very recently, and is, in fact, still occasionally employed, though it has been in great measure superseded by other systems which present very important advantages. It consists in inserting into the charge of gunpowder a short piece of thin wire, composed of a metal of inferior conducting power, such as iron or platinum, and placing this wire into connection with the circuit wires of the battery. The resistance offered to the passage of the current gives rise to the development of heat, the intensity of which is regulated by the conducting power and the length and thickness of the wire. The latter may, in this way, be raised to a red heat, or even fused; and thus, by completing circuit through the wire at the desired moment, a charge of powder may be inflamed. A number of charges may be simultaneously exploded by introducing several pieces of thin wire into the circuit.

Although the employment of a voltaic current of low tension presents obvious and great advantages over old systems of igniting charges by trains or slow-burning fuses, its application to military purposes is attended with some difficulty and uncertainty, arising out of the want of uniformity of action of the same voltaic arrangements at different periods, the difficulties attending the transport and proper preservation of the battery and materials required for its use, the dependence for success upon care and experience in preparing and preserving the batteries, and the very considerable increase which it is necessary to make in the power of the battery when the operations to be performed involve the simultaneous explosion of a number of charges, or the ignition of gunpowder at very considerable distances from the battery.

For these reasons, soon after the first successful application of voltaic electricity to mining purposes, the attention of military Engineers on the Continent, and of others here and abroad who were specially interested in operations of this kind, became directed to the possibility of rendering electricity of high tension available for exploding purposes, whereby voltaic batteries, for mining operations, might be greatly reduced in size, if not altogether dispensed with.

In 1853, a Spanish officer, Colonel Verdu, associated himself with M. Ruhmkorff in experiments on the application of electro-magnetic induction coils to the explosion of gunpowder. The success of their experiments led Colonel Verdu to pursue them further in Spain, where he soon succeeded in firing six mines simultaneously by one element of Bunsen's battery, at a distance of upwards of three hundred yards, through the agency of the Ruhmkorff coil. The mode of operating and difficulties which Colonel Verdu had to overcome will be presently described. While the success of these operations led the military Engineers in Spain, France, and Russia to pursue the development of the application of electro-magnetic induction instruments to exploding purposes, a committee of Austrian military Engineers (of which Baron von Ebner was from the first a most distinguished member) was labouring to apply frictional electricity to military uses as an exploding agent, having come to the conclusion that the electro-magnetic induction apparatus was too complicated and too greatly susceptible of derangement for military uses. But little success had up to that time attended attempts to apply frictional electricity to this purpose. In 1831, Moses Shaw, of New York, succeeded in exploding several mines simultaneously by means of frictional electricity, but was foiled in his attempts to apply this agent to practical purposes, by the fact that he could not conduct operations with any chance of success except in very dry weather. Somewhat more promising results attended several attempts in Germany between 1842 and 1845; but the prospect of practical success was still not encouraging when the Austrian Committee of Engineer Officers took the matter in hand, and eventually produced a portable

* *A lecture delivered before the Royal Institution of Great Britain, March 12, 1869.*

glass frictional electric machine, which, when in good working order, furnished results surpassing those which had been obtained with volta-induction apparatus. Some very extensive operations were conducted with this machine; thus, fifty land charges and, afterwards, thirty-six submarine charges, were simultaneously exploded. Even, however, with all the precautions adopted, the machine was still too seriously affected by damp to be thoroughly serviceable for military purposes. But the persevering labours of Baron von Ebner eventually resulted in the production of an electric machine which was almost entirely free from the objections hitherto attached to this form of apparatus.

While the progress just indicated was being made in different parts of the Continent in the application of electricity to mining operations, but little attention was directed in this country to effecting improvements in the utilisation of electricity for military mining purposes. In 1855, however, Sir C. Wheatstone directed the attention of Field-Marshal Sir John F. Burgoyne to the importance of instituting an experimental inquiry into the relative advantages of different sources of electricity of tension as agents for exploding gunpowder. The Ordnance Select Committee, of whom Sir C. Wheatstone and Mr. Abel were then members, were consequently instructed to pursue this inquiry; and a series of investigations was carried out, in the first instance, to a working branch of the Committee, and subsequently by Mr. Abel at Woolwich and Chatham, the results of which were eventually embodied in a report presented by the above-mentioned gentlemen to the Secretary of State for War in 1860. Since then Mr. Abel, as a member of the Government Committee on Floating Obstructions, has continued systematic investigations on the applications of electricity to the explosion of mines, and especially to submarine operations, and considerable improvements and simplifications of the arrangements and appliances have resulted. Some advance has also been made on the Continent in this subject, and during the last two or three years our military Engineers have acknowledged in the most practical manner the advantages to be derived from the use of electricity of tension as the agent for exploding mines, by gradually, and to a very great extent, abandoning the old system of operation, and by devoting considerable attention to the practical elaboration of the new systems.

The following is an outline of the results obtained up to the present day with different classes of instruments which furnish electricity of tension.

It has been stated that Colonel Verdu succeeded, in 1853, in exploding several mines simultaneously by means of a Ruhmkorff induction coil. The ignition of the gunpowder was effected in these experiments by introducing one or more small but complete interruptions into the circuit, across which the electric spark of high tension would leap upon the current being passed. This spark will inflame gunpowder, but not very readily, although its production is attended with development of heat considerably in excess of that required; the reason being that powder requires for ignition either the close proximity of a considerable heated surface, or the continuous application to heat for a brief period, while the disruptive discharge from an induction coil consists of a series of instantaneous discharges following each other in very rapid succession. Hence a charge of gunpowder is not always instantaneously fired when the spark is passed; indeed, unless the powder be closely confined round the wire terminals between which the spark passes, it is sometimes dispersed by the mechanical action of the spark without being exploded; and when a succession of sparks is passed simultaneously through a number of charges, it frequently happens that only a few are exploded, in which some of the grains happened to be in positions or conditions more favourable with reference to the source of heat than in other instances, where the powder would escape ignition. Colonel Verdu succeeded in increasing the certainty of simultaneous ignition of several charges, by surrounding the wire terminals with a substance much more readily inflamed than powder—the fulminate of mercury. Another source of difficulty in effecting the simultaneous ignition of a considerable number of charges by the spark from the coil is the enfeebling effect upon the spark-discharge exerted by a number of successive small interruptions in the circuit. This was to some extent overcome by employing a fuse constructed by Messrs. Statham and Brunton, in which the space between the wire terminals was bridged over with a film of a finely-divided substance—the subsulphide of copper—the conducting power of which is sufficiently great to aid the passage of the electric discharge across the interruption, while it is at the same time readily combustible, and therefore directly promotes the ignition of the powder. Finding that, even with the combined use of this fuse and of fulminate of mercury, the power of the induction coil to explode charges simultaneously was limited, Colonel Verdu adopted the following simple arrangement:—Separate small groups of mines were all connected with earth, and an insulated conducting wire connected each group with a distinct small insulated plate. By bringing these plates in very rapid succession into circuit with the coil machine, the several groups were so rapidly exploded as to produce results somewhat similar to those attainable by the really simultaneous discharge of a considerable number. Not long after this contrivance was adopted by M. Verdu, M. Savare devised another arrangement, whereby a much more rapidly successive discharge of a number of mines was accomplished through the agency of the coil. The metallic circuit which passed to the mines was divided into a number of branches, so that, upon completion of the circuit, the currents, following each other in very rapid succession, would distribute themselves through all the branches with a degree of uniformity regulated by the resistance met with in each branch. Thus, when one or more fuses were interposed in each branch of the circuit, those which happened to offer the greatest facilities for the passage of the current would be first fired, whereupon the escape of electricity in that direction would be interrupted, and the explosion of fuses in the other branches would follow. With the employment of currents following each other with the enormous rapidity with which they pass off from the induction coil machines, the discharge of a number of mines may thus be effected with a rapidity which, practically, has almost the effect of a simultaneous discharge.

The Ruhmkorff coil was used to some extent by the Russians in mining operations during the Crimean war, and some very extensive blasting operations were carried on with its aid at Cherbourg in 1854. A series of experiments was instituted at Woolwich in 1856 with two excellent induction coils, produced by M. Ruhmkorff, in the course of which various descriptions of materials were tried in the fuses, for the purpose of increasing the power of the machine to fire numbers of charges simultaneously. At that time the fulminate of

mercury was found to be the best inflaming agent; but not more than twelve charges were fired simultaneously by means of the most powerful coil available and a battery of twelve cells (without employing Verdu's or Savare's methods of explosions). One defect in this class of instrument was found to be the want of uniform action of one and the same apparatus at different periods; another was the liability to derangement of the machine, especially of the condenser. Far more successful results were afterwards obtained with the same coils and the fuse constructed at a later period of these investigations; fifteen charges were fired simultaneously with a battery of six cells, and fifty charges, arranged in branch-circuit in groups of ten, were exploded with the effect of a simultaneous discharge. These results were obtained with machines produced by Ruhmkorff in 1855; but the improvements since then effected in the construction of this apparatus have reduced to insignificance the results at that time obtained with it. There is no question therefore that the Ruhmkorff coil is available for special operations of considerable magnitude; but in point of simplicity, certainty, and constancy of action, it is far surpassed by other forms of electric instruments, which will be presently noticed.

At the suggestion of Sir Charles Wheatstone, experiments were commenced in 1856 on the application of currents *induced by permanent magnets* to the explosion of gunpowder The first experiments were instituted with a very large and powerful magneto-electric machine, constructed by Mr. Henley, of which the armature, carrying two powerful coils, was suddenly detached from the magnet by means of a lever. A few experiments sufficed to show that the induced current obtained even with this powerful instrument was not adequate to ignite one single charge of gunpowder with certainty. Somewhat better, but still uncertain, results were obtained with Statham's and one or two other forms of fuses existing at that time. A careful investigation was then undertaken by Mr. Abel (with the invaluable assistance of Mr. Brown, of the Chemical Department, Woolwich), into the conditions to be fulfilled in the production of a fuse which should be certain of action with the magneto-electric machine. The results of extensive experiments indicated that a combination of comparatively high conducting power with great susceptibility to ignition appeared to be essential elements of success in a material as the exploding agent in a fuse. The uniform arrangement of the poles or wire terminals in the fuse, the space between which was to be bridged over by the igniting composition, also proved a matter of great importance. A mode of constructing the fuses which ensured perfect uniformity in this respect was ultimately perfected, and has proved quite successful. A very fairly efficient fuse was obtained with the aid of the poles thus arranged, by employing as the igniting agent gunpowder impregnated with a small proportion of calcic chloride, which caused it, upon brief exposure to air, to imbibe moisture sufficient to render the gunpowder highly conducting. It is obvious, however, that, although the fuse itself was hermetically closed when complete, there must be a liability to want of uniformity in the proportion of water absorbed by the powder, and a consequent variation in the conducting power of the latter. Eventually a material was prepared (consisting of the subphosphide of copper, subsulphide of copper, and potassic chlorate) which combined the essentials of perfect certainty of action with very great sensitiveness to ignition. *Henley*'s large magnet fired *three* of these fuses simultaneously with perfect certainty, while a small horse-shoe magnet with revolving armature exploded 25 in divided circuit in exceedingly rapid succession. A combination of six small compound magnets was afterwards employed, with which an exceedingly rapid succession of currents was obtained, and this apparatus exploded twenty-five fuses in divided circuit with a rapidity which to the ear had the effect of an instantaneous explosion. Even the small magneto-electric instruments which are used for medical purposes will explode these fuses with certainty.

The application of magneto-electric machines having been successfully accomplished, a series of experiments was carried on by Mr. Abel, with the valuable aid of Colonel H. Scott, R. E., at Chatham, during the years 1857-58, on the explosion of charges, both land and submarine; and the great advantages of these instruments, as regards simplicity and permanent efficiency, over the voltaic arrangements hitherto used, was fully demonstrated. Very compact but powerful exploding instruments were constructed by Sir C. Wheatstone, and these have for the last seven or eight years received many important applications; thus, the proof of cannon at Woolwich and the firing of guns, from a safe distance, in the numerous experiments at Shoeburyness, is effected by means of Wheatstone's exploder, which is, moreover, an important adjunct in all electro-ballistic experiments, when the operator desires himself to fire a gun at a particular moment. Magneto-electric machines have also been found very useful in connection with blasting operations on land, except in instances when the absolutely simultaneous explosion of a large number of mines is required.

Since the success of Wheatstone's exploders has been fully established, several other forms of magneto-electric machines have been devised, especially on the Continent and in America. Powerful instruments similar to Wheatstone's are manufactured by Siemens and Halske, of Berlin; Markus, of Vienna, has constructed very efficient instruments in which one separation and return of the armature to the magnet are made to explode the charges. The disadvantages of these instruments is that a *succession* of currents cannot be obtained from them as in the case of machines with revolving armatures; hence the number of mines which can be exploded by them in divided circuit is comparatively limited. Mr. Beardslee, an American, has also devised a modification of Wheatstone's exploder, in which the magnets are made to revolve between the armature coils, and which furnishes currents of greater quantity but lower tension than Wheatstone's. The fuse constructed by Mr. Beardslee, for employment with this instrument, is similar in principle of construction to Abel's; but the materials which bridge over the space between the terminals or poles of the fuse are black-lead, with the addition of a minute quantity of some substance, apparently collodion, which adds to the size of the scintillations produced when the current passes, and thus increases the certainty of ignition of the powder which is in close contact with the poles. These fuses are efficient with magneto-electric instruments like that of Mr. Beardslee, but they are much less delicate than the Woolwich fuses, and the number which can be simultaneously exploded is therefore much more limited. Sir C. Wheatstone has also lately constructed more powerful modifications of his original magnetic exploder, which may, at will, be made to furnish currents of greater quantity and lower tension, or to produce the high tension currents. Lastly, Mr. Ladd and Mr. Browning

have produced instruments of comparatively low price, but quite powerful enough for ordinary blasting and quarrying operations. The only obstacle, but a most important one, to the general use of these machines, for the explosion of mines on land and under water is, that very slight defects in the insulation of the conducting wire which leads from the instrument to the mines are quite fatal to its exploding power. In consequence of the high tension of the current developed by these machines, and the small quantity put into circulation by even the most powerful of them, the diversion of the current from its destined course to earth is promoted by the smallest points of escape presented to it; a result which is, moreover, facilitated by the resistance of the fuses in circuit. With care this source of failure can be guarded against in operations on land, but such is not the case with regard to submarine arrangements; while, moreover, minute defects in the coatings of the *submerged* wires, which would hardly influence the results at all on land, completely nullify the exploding power of the machines. Hence magneto-electric instruments are the least reliable of all electric exploding apparatus for submarine purposes.

A few experiments were instituted at Woolwich in 1857 on the employment of *frictional electricity* as an exploding agent, and especially with a small hydro-electric machine constructed for the purpose by Sir William Armstrong. As regards its power of exploding a number of charges simultaneously, when it was in good working order, it far exceeded any other instrument experimented with at that time: one hundred fuses, arranged in a single current, were frequently exploded by its means; but the great uncertainty of its action, and the difficulty of employing it in the field did not afford encouragement for a continuation of experiments with it.

The great difficulties encountered in the Austrian experiments in the attempts to employ glass frictional electric machines as exploding agents for military purposes, led Baron von Ebner to direct his attention to the production of an instrument in the construction of which glass was altogether avoided, and which might therefore be expected to be less subject to atmospheric influences. His labours in this direction were eventually crowned with success; for he found in the hard vulcanised india-rubber (known as ebonite or vulcanite) a dielectric material excellently adapted to the construction of the frictional apparatus; while by employing a sheet of vulcanised india-rubber coated with tin-foil and compactly rolled up he obtained without the use of glass a powerful condenser, or Leyden jar arrangement. The improved machines were constructed in a very compact form (with cases excluding all the working parts from direct exposure to air) by Messrs. Siemens, of Berlin, and Lenoir, of Vienna, who exhibited specimens in England in 1862, at which time the electric machine had already received important applications in the Austrian service, and had been regularly adopted for military uses. Baron von Ebner had also, from the commencement of the Austrian experiments, laboured assiduously at the production of an efficient fuse to be used with electricity of tension; and the Austrian service is indebted to him for a simple and thoroughly serviceable fuse, which, as regards the arrangement of its poles and the character of the igniting composition, may be said to combine the principles of the Statham and Abel fuses. Though less sensitive than the present English service electric fuse, a very considerable number may be exploded in simple circuit by the ebonite electric machine. The power of this apparatus in its portable form is nearly equal to that of the hydro-electric apparatus just now referred to, when the latter is in perfect working order. A far greater number of mines may therefore be simultaneously exploded by its means than by very large batteries or by the most powerful magneto-electric machines hitherto constructed. One hundred of Abel's fuses have frequently been simultaneously exploded with one of the portable machines, and still greater results can be obtained with a larger instrument having a battery of condensers, which was specially constructed for submarine operations by Mr. Becker, at the suggestion of Captain Maury. In very damp weather, when the most perfect glass electric machines would have been useless unless housed in a warm apartment from which the external air was as much as possible excluded, these ebonite machines have been used from time to time throughout the day with very satisfactory results.

Another important advantage which these instruments possess over magneto-electric machines consists in the fact that very considerable defects in the insulation of even submerged conducting wires do not so greatly reduce the power of the current furnished by them as to interfere with the accomplishment by its agency of the most extensive operations under water which are likely to occur in practice. Unfortunately, however, the very circumstance which constitutes its chief advantage, namely, the powerful character of the current of high tension with which it charges an insulated wire, is also a source of serious defect, to be presently noticed, which very greatly limits the applicability of these machines to naval and military purposes.

A class of electrical instruments has been created within the last three years which bids fair to supplant even these very powerful and efficient frictional machines. The instruments in question, of which different forms have been devised by Wheatstone, Wilde, Siemens, and Ladd, have received the generic name of *dynamo-electric machines*, because dynamic force becomes through their agency a direct and powerful source of electricity. In the machines of Siemens, Wheatstone, and Ladd, mechanical power is transformed into electric force without the intervention of permanent magnets. The action of the most simple form of these instruments may be described as follows:—The residual magnetism existing in an electro-magnet suffices to develop an induced current in a rapidly revolving coil armature; this current, reacting upon the electro-magnet, determines the development of powerful magnetism in the latter by the inductive action of its insulated coils; the currents developed by the electro-magnet are consequently in their turn greatly increased in power, and react again upon the armature; and thus an immense accumulation of electric force is accomplished with great rapidity, until, when that accumulation has reached the maximum attainable without detriment to the insulation of the wire coils, a simple interrupting arrangement causes the current to be diverted from the machine to conducting wires, by whose medium it is utilised. The details of the machines vary according to the different plans adopted by the several constructors, but the above explanation applies more particularly to the machines of Messrs. Siemens and Halske, who have been the first to produce a small instrument of this class thoroughly applicable to mining purposes, and which almost

equals in power the ebonite frictional electric machine. Fifty charges, arranged in simple circuit, have been repeatedly exploded, without any failures, by one of these machines; it therefore provides with certainty the power necessary for the most extensive mining or submarine operations, and is at the same time quite free from all disturbing atmospheric influences. Its mechanism is simple, and less easily susceptible of derangement than that of any magneto-electric apparatus, and as it is independent of everything but the application of manual power for the development of its action, it is far superior to the most perfect of these, independently of the fact that it surpasses them all greatly in power. For many important military and mining operations the hand dynamo-electric machines, constructed by Messrs, Siemens and Halske, are therefore unquestionably superior to all other existing apparatus which furnish electricity of tension. This class of instrument, however, shares, to some extent at any rate, one important defect of the frictional-electric machines, which is consequent upon the powerful charges of high-tension electricity sent into conducting wires by their agency. It was observed, in the early experiments of the Austrians with frictional electricity, that if two or more insulated wires which led to distinct mines were situated side by side, in moderately close proximity, even only for comparatively short distances, the charge sent from the machine into one of the wires, with the view of only exploding a particular mine or series, might develop in neighbouring wires, not connected with the machine, a charge of induced electricity of sufficient power to explode the mines connected with those wires. Some results obtained at Chatham and many experiments recently instituted at Woolwich have not only confirmed those observations in Austria, but have shown that means do not at present exist of avoiding this serious defect of powerful charges of high tension. If, therefore, it is necessary to lead separate wires from the point of operation (from the exploding instrument) to different mines or groups which it is desired to explode independently of each other, it is impossible to employ the frictional electric machine as the exploding agent without great risk of failure, even though the wires, laid upon or imbedded in earth, are separated as widely as possible, as they must unavoidably extend in proximity to each other to a distance from their points of union with the machine, which, if the latter be highly charged, may prove sufficient to determine the development of induced "exploding" currents in the wires leading to mines not intended to be fired. If the wires lead to submarine mines or torpedoes, and are therefore submerged, the unintentional explosion of mines becomes much more certain, and the frictional machine is consequently inapplicable to submarine operations in all instances where mines are arranged in separate circuits. The dynamo-electric machines share this serious defect to some extent; still, with proper experience in their use; they are not altogether inapplicable to such services as above specified. If Siemen's dynamo-electric machine be highly charged by very rapid revolutions of the armature, the inductive action of the charge will be similar in power to that exerted by the charge of the frictional machine, but, by revolving the armatures slowly, it is possible to charge the machine sufficiently to fire a mine or a small group with certainty, while the inductive action of the charge sent into the wire will not influence neighbouring wires to an extent sufficient to cause the explosion of mines connected with them.

The subject of the application of electricity to the explosion of submarine mines for purposes of defence and attack received some attention from the Russians during the Crimean war, and was practically developed in its most simple form in 1859, in the hands of the Austrian Government, when a system of submarine mines, to be fired through the agency of electricity by operators on shore, was applied by Baron von Ebner to the defence of Venice, which, however, never came into practical operation. The subject of the utilisation of electricity for purposes of defence did not, however, receive serious consideration in England or other countries until some years afterwards, when the great importance of submarine mines as engines of war was demonstrated by the number of ships destroyed and injured during the war in America. Twenty-five vessels belonging to the Federal navy were destroyed and nine others injured by the explosion of torpedoes, while the Confederates lost three vessels by accidentally coming into collision with their own torpedoes, and one which was attacked by means of a torpedo and destroyed by the Federals.

Soon after the commencement of that war the attention of the English Government was called to the importance of practical inquiry into the value of submarine obstructions, both passive and active, as auxiliary agents of defence, and a committee was appointed at the suggestion of Colonel Jervois, C.B., R.E., to report on the use which might be made of floating or sunken obstructions and of submarine mines, in the defence of channels, harbours, and rivers. The labours of this committee have recently terminated, and they were enabled, by the aid of systematic investigations conducted for them at Woolwich during the last four years by one of their members, Mr. Abel, and of practical experiments carried on chiefly at Chatham under the direction of another of their body, Colonel A. à'C. Fisher, C.B., R.E., to elaborate the subject of the application of electricity to submarine mines and torpedoes, to such an extent that a solid foundation of information and instruction is now available for those who may at any time have to be entrusted with the actual arrangement and employment of these important means of defence. Continental Governments have also devoted much attention to this subject, and especially the Austrian Government, for whom Baron von Ebner devised an ingenious and elaborate system of electric torpedo defence, exhibited in detail at the Paris Exhibition of 1867, which received application during the recent war, though its efficiency was not actually put to the test except in the way of experiment.

The application of electricity to the explosion of torpedoes was very limited during the American war; but arrangements for the extensive employment of that agent as the exploding power were far advanced in the hands of both the Federals and Confederates at the close of that war. It appears that only in two instances of the entire number of vessels destroyed and injured was the explosion of the torpedoes effected by electric arrangements, the others having all been exploded by mechanical agency.

The explosion of submerged charges of gunpowder by mechanical contrivances, either of a self-acting nature or to be set into action at desired periods, was accomplished as far back as 1583, during the siege of Antwerp by the Duke of Parma. The English employed self-acting torpedoes against the French ships off Rochelle in 1628, and from that period to 1854 devices of more or less ingenious and practicable cha-

racter have been proposed from time to time, and even applied to some small extent in different countries, for the explosion of torpedoes either by clockwork, at fixed periods, or by coming into collision with a ship. The Russians were the first to apply self-acting mechanical torpedoes with any prospect of success, and there is little doubt that had the machines which were applied to the defence of the Baltic been of larger size (they only contained 8 or 9 lbs. of gunpowder), their presence would have proved very disastrous to some of the English ships which came into collision with and exploded them. Various mechanical devices for effecting the explosion of torpedoes by their collision with a ship were employed by the Americans during the recent war, a few of which proved very effective. But although, in point of simplicity and cost, a system of defence by means of mechanical torpedoes possesses decided advantages over any extensive arrangements for exploding submarine mines by electric agency, their employment is attended by such considerable risk of accident to those at whose hands they receive application that, under many circumstances which are likely to occur, they become almost as great a source of danger to friend as to foe. Thus the operations of lowering and mooring torpedoes, the explosion of which depends upon the application of a blow, thrust, or pull to some portion of the machine, which is so placed and arranged as to be in a favourable position for the application of mechanical action by a passing ship, are attended with very great danger to those employed, unless some means are adopted for rendering the exploding mechanism inactive until after the torpedo has been placed in position. But the employment of a safeguard of this kind involves a considerable amount of uncertainty as to the torpedo being rendered active, by its removal after the operation of mooring is completed, because this very removal is frequently a dangerous operation. Again, when once the mechanical torpedoes have been placed in position and rendered active, they are as dangerous to friendly ships as to the enemy; consequently their employment for the defence of a particular tract of water completely closes it until the torpedoes have been exploded or removed, and their removal obviously constitutes one of the most dangerous services upon which men can be employed. Several instances have recently occurred in America of the destruction of ships in waters defended during the war by mechanical torpedoes, of which it was believed that the subsequent removal had been completely accomplished. Some improvements have recently been made in mechanical and chemical appliances of a self-acting nature for torpedoes by the employment of which the mooring arrangements can be completed with perfect safety, and the torpedoes afterwards rendered active, by the performance of a simple and safe operation when it is desired to close the defended water. But the complete exclusion of friendly vessels, and the difficulties attending the raising of the torpedoes when no longer required, still constitute formidable objections against the use of mechanical torpedoes, excepting in the case of tracts of water which are not ordinarily navigated, but the passage of which in times of war might be attempted by vessels of light draft.

The most important advantages secured by the application of electricity as the exploding agent of submarine mines and torpedoes are as follows:—They may be placed in position with absolute safety to the operators; they may be rendered active or passive at any moment from the shore; the waters which they are employed to defend are therefore never closed to friendly vessels until immediately before the approach of an enemy; they can be fixed at any depth beneath the surface (while mechanical torpedoes must be situated directly or nearly in the path of a passing ship), a circumstance which very considerably simplifies the arrangements for their application in tidal waters; lastly, electric torpedoes may, when no longer required, be removed with as much safety as attended their application.

There are two distinct systems of applying electricity to the explosion of torpedoes. The most simple is that in which the explosion of a torpedo is made dependent upon the completion of the electric circuit by operators stationed at one or more posts of observation on shore. The particular mode of arrangement and the operation to be adopted depend in great measure upon the nature of the locality to be defended by torpedoes. If this be a river or channel, the plan of arranging and exploding torpedoes is comparatively simple, but will serve sufficiently to illustrate the general nature of this system of applying torpedoes. The mines are arranged across the river or channel in rows or lines, converging towards a station on shore, to which the conducting wires are led which are to connect each torpedo with the exploding instrument. The operator at this station has it in his power, therefore, to explode any one of the torpedoes at will, by completion of the circuit through the particular cable and the earth. Some other position on shore is selected as a second station, which commands points of view intersecting the lines of torpedoes. The operators at the two stations are placed in telegraphic communication with each other, and when a ship is observed by the operator at the second station to approach the direction of any one of the torpedoes, he will signal to the man who looks along this line of torpedoes, and the latter will complete circuit as soon as the vessel appears over the particular torpedo specified. Should the vessel alter her course in approaching the torpedoes, the operator at the observing station will inform the man at the firing station, who will alter his arrangements accordingly. Or, the man at the observing station, when he perceives a vessel to approach in a line with any of the torpedoes, places the cable of that torpedo in electric connection with the operator at the other station, and the latter will complete the circuit through the earth to the torpedo as soon as he sees that the vessel is over the first line of torpedoes. Other more or less elaborate modifications of these modes of observing and exploding have been proposed; they all depend for efficiency upon the experience, harmonious action, and constant vigilance of the operators at the exploding and observing stations. They are, moreover, entirely useless at night, and in any but clear weather. They are therefore not to be compared, in general efficiency, with self-acting electric torpedoes, which are either exploded by their collision with a ship, whereby electric circuit is completed within them, or by the vessel striking a circuit-closing arrangement moored near the surface of the water, whereupon either the torpedo, moored at some depth beneath, is instantly exploded, or a signal is furnished at the station on shore, which indicates to an operator the particular torpedo to be exploded. The object to be attained in these circuit-closing apparatus, which are so moored as to be within range of a passing ship, is to oppose in the path of a vessel a contrivance which will not be affected by the motion of the water, but which will complete electric circuit between the conducting cable and the fuse, if

struck in some particular part, or thrown into a particular position, by the advancing ship. Numerous ingenious contrivances have been proposed for this purpose and experimented with, but in only two or three instances have satisfactory results been attained, the conditions essential to success being numerous, and their combined fulfilment not easy of attainment. Simplicity of mechanism and a combination of sufficient, but not excessive, delicacy of action, with permanence during long immersion, are among the most important objects to be aimed at in the construction of these circuit-closing or signalling machines, or self-acting torpedoes, which, if efficient, must contribute most importantly to the success of any arrangements for defence of a water by electric torpedoes.

It has been shown that magneto-electric instruments cannot be relied upon for submarine operations, on account of the perfect insulation of the conducting wires, joints, &c., required to insure success with machines of that class. On the other hand, frictional machines and also dynamo-electric machines leave little to be desired as regards power to effect even the simultaneous ignition of numerous submarine mines, through cables in the insulation of which, from long-continued use, some defects exist. Th se instruments, therefore, are available as most efficient instruments when any extensive submarine operations have to be accomplished; but the frictional machines cannot be used as the exploding agents in connection with any system of defence by torpedoes which depends for its efficiency upon the explosion at the proper moment of only the particular torpedo over which a vessel passes, while all surrounding torpedoes still remain intact; because, for the reason which has been given, the explosion of the proper torpedo will almost invariably be attended by the accidental explosion of others which it is not desired to bring into operation. The same objection applies, at any rate to some extent, to the dynamo-electric machines. These two classes of instruments are therefore only susceptible of certain special applications in connection with submarine mines. There is, moreover, another general objection to the use of any source of electricity, the action of which is entirely dependent upon an operation to be performed at the instant that an electric discharge is required. This consists in the fact that, although the torpedoes may be self-acting, their efficiency is still dependent upon the vigilance and presence of mind of an operator on shore.

The only sources of electricity which thoroughly fulfil the conditions essential to its application with perfect confidence in connection with self-acting torpedoes, are constant voltaic batteries. By substitution of the Abel fuse for the old platinum-wire fuse, it has become possible to use batteries which were previously inapplicable to the explosion of mines, because, even when employed in considerable numbers, the quantity of electricity furnished by them is not sufficient to effect the ignition of platinum wire. Thus, a number of elements of a Daniell's battery, or a sand battery, quite incapable of heating a platinum wire to redness, fires an Abel fuse with perfect certainty. The heat developed in the latter by the passage of a current from such a battery amply suffices to raise to its igniting point the readily explosive priming mixture which serves as the conductor in the fuse. Moreover, the resistance presented by the fuse is so considerable in comparison with that offered by the longest cables which are likely to be used in actual practice, that a current from a battery which possesses tension sufficient to overcome the resistance of the fuse will explode the latter with as much certainty, through cables of great length, as when it is close to the battery. A number of cells of a Bunsen's battery, sufficient to ignite a piece of platinum wire several inches in length, when close to the battery, the current of which possesses also sufficient tension to ignite an Abel fuse, will be incapable of rendering a very short piece of thin platinum wire even moderately warm, if four or five hundred yards of ordinary conducting wire be introduced into circuit; but its power of exploding an Abel fuse will not have become at all affected. It is evident from this illustration that the necessity for greatly adding to battery power, when mines are to be exploded through considerable lengths of wires, which exist with the use of the wire fuses, is obviated by employing the new fuse; and thus one great objection to voltaic batteries, as exploding agents in mining operations, is set aside. Again, the sand batteries, or Daniell batteries, which are used for telegraphic purposes, and which when once charged, continue, with very little attention, in constant and good working action for several months, may now be substituted for the batteries (*e. g.*, Grove's or Bunsen's) which it was formerly necessary to employ in order to attain sufficient quantity of current, and which only continue in good action for a few hours. Sand batteries have been repeatedly employed at Woolwich for the explosion of fuses, after having been in action four or five months, with the occasional addition of a little water to compensate for evaporation.

It will be seen, from the foregoing, that constant voltaic batteries combine more thoroughly the essential qualifications of efficient exploding agents, in connection with any system of submarine defence, than all other sources of electricity at present known. They are simple of construction, inexpensive, require but little skill or labor in their production and repair, and very little attention to keep them in constant good working order for long periods. Their action is quite independent of any operation to be performed on shore at the last moment; it is only necessary to place the cables leading to the torpedoes in connection with the battery when it is desired to close a defended water—the circuit-closing portion of the torpedo, upon being struck by a ship at any time, will then cause the instantaneous explosion of the charge. The defence by torpedoes thus becomes as effective by night as by day; moreover, the efficiency of the constant batteries is not more prejudicially affected by the existence of defects in the insulation of the cables than that of the frictional electric machines; and they may be used without incurring any risk of the unintentional explosion of torpedoes by induced currents.

Simple and powerful forms of batteries are readily extemporized, and there is no more portable, simple, or economical description of exploding instrument than the ordinary volta-pile, for the construction and employment of which it is only necessary to provide a piece of hard timber, some zinc and copper sheet, an old blanket, and some vinegar and common salt. A pile, composed of 120 elements, the plates being 2¾ inches in diameter, is very portable, and suffices to explode a mine in single circuit, or three or four arranged in branch circuit. It will remain in good action for at least twenty-four hours, and is readily and expeditiously cleaned and re-charged. This apparatus has become a favorite exploding instrument with sailors, being easily constructed and charged anywhere, and very handy for boat operations (in connection with the employment

of torpedoes as an arm of attack), in which service more delicate instruments speedily lose in efficiency. Larger piles constructed on precisely the same plan are now being used in some ships of war for the simultaneous discharge of guns, and a very small form of pile, with water only as the exciting agent, is the most convenient instrument for testing the fuses and cables of torpedoes after they are in position. It is a matter of great importance that a positive knowledge of the efficiency of a torpedo and its conducting wire should be obtained from time to time by electric tests, and there is now no difficulty in including the fuses themselves in the test. Signals may, in fact, be readily passed from one firing station to another through the fuse in a submerged torpedo, which is arranged to be fired at will from the shore.

It does not come within the scope of this discourse to enter upon a discussion of numerous important subjects connected with the actual use of electric torpedoes, or of the considerations involved in the question as to how these formidable agents of defence may be most efficiently applied, in addition to, or in the absence of, artillery defences. The object of the discourse will have been attained if it has been satisfactorily demonstrated that electrical science is destined to contribute most invaluably to the efficiency of a country's defences.

ON THE

ESTIMATION OF COPPER IN ORES,

BY CERTAIN METHODS FOR WHICH A PREMIUM HAS BEEN AWARDED.

(Concluded from Am. Repr., June, 1869, page 299.)

Estimation of Copper in the Mansfeld Ores, according to the Method proposed by M. C. Luckow, at Deutz.

FOR a few years, the gentleman just named has applied to the quantitative estimation of copper present in salts, alloys, and ores, a new method, based upon the precipitation of the metal in metallic state, from solutions containing either free sulphuric or nitric acids, by means of a galvanic current.

It is a great advantage of this method, that, while the copper is precipitated, it is simultaneously separated from metals with which it is often found alloyed, some of which, such as tin and antimony, are separated by treatment with nitric acid in an insoluble form, while others, like silver, can easily be removed in the form of chloride. It is, at the same time, another advantage that the state in which the copper is obtained, admits of its being accurately weighed and estimated, while a great number of operations, which require much time and various apparatus, is, at the same time, got rid of.

Although, already some four years ago, M. Luckow had discovered a method of electro-metallic analysis from fluids containing free sulphuric acid, his researches on the same subject, in the case of free nitric acid, belong to a later period. These researches brought very unexpectedly to light the curious fact, that even a weak galvanic current had the power to completely precipitate copper in a pure metallic state, from solutions which did not contain more than 0·1 grm. of anhydrous nitric acid to the c.c. (nitric acid of 1·2 sp. gr. contains 0·32 grm. of anhydrous nitric acid to the c.c.), while it was, at the same time, found that the action was more regular, and less dependent upon the power of the current than when free sulphuric acid was present. The following more commonly occurring metals are *not* precipitated by galvanic action from acid solutions:—Zinc, iron, nickel, cobalt, chromium, the metals of the earths, and alkalies. There are precipitated—

(*a*). In the shape of peroxides, at the positive electrode: completely, lead and manganese; incompletely, silver. When the solution contains traces of manganese, it becomes, in consequence of the formation of a salt of peroxide of manganese, or permanganic acid, deeply violet coloured. This very sensitive reaction for manganese also takes place when small quantities of chlorine are present. The presence in the fluid of oxalic, lactic, and tartaric acids, and other readily oxidisable organic substances, and such protoxides as are readily peroxidised—for instance, protoxide of iron—retard the formation of peroxides, as well as the setting-in of the reaction of manganese.

(*b*). Precipitated at the negative electrode in metallic state, are mercury, silver, copper, and bismuth. When mercury is present in the solution simultaneously with copper, the former metal is separated before the latter, in the fluid metallic state. As soon, however, as the precipitation of copper commences, there is, when mercury is also present, formed an amalgam of the two metals. Silver is precipitated almost simultaneously with copper; bismuth only begins to be precipitated after the greater portion of the copper has been already separated. A complete separation of silver only ensues when some such substance as tartaric, or any other similar acid is simultaneously present in the solution. The separation of the three last-named metals, by means of galvanic action, is, therefore, unsuccessful; but, fortunately, we have plenty of other means to accomplish this end completely.

(*c*). Metallic arsenic is only precipitated slowly; and long after the complete separation of copper, is the former metal separated from arsenic acid, if it should happen to be present. The same remark applies to antimony, since it is well known that small quantities of antimonic acid are soluble in nitric acid.

The operations, according to Luckow's plan, are—I. Roasting of the ore; II. Solution of the roasted product; III. Precipitation of the copper; IV. Weighing of the copper.

I. *Roasting of the Ore.*

Care should be taken to obtain a finely-ground, average sample of the ore. M. Luckow then weighs off, in previously accurately counterpoised small porcelain capsules, quantities of from 1 to 3 grms.; these quantities are then placed on the inverted lid of an iron crucible, on the inner surface of which the powdered ore is heated, over the flame of a Bunsen gas-burner. The powder may be carefully stirred up with a platinum wire, to promote the access of air during the roasting, and the ignition of bituminous matter and sulphur may be ended in about seven minutes. Ores which do not contain bitumen at all need not be roasted.

It has been already stated that, especially as regards poor copper ores (and those of the Mansfeld district are generally so), the quantities to be weighed off for assay should not vary according to a presumed percentage of copper. One gramme is too small a quantity; 2 grms. are now taken, and, instead of roasting the ore on the lid of an iron crucible, small porcelain crucibles are applied for that purpose.

II. *Solution of the Roasted Product.*

According to M. Luckow's plan, the iron lid is suffered to cool, the roasted powder placed on a piece of glazed

paper, and any powder adhering to the lid is removed by means of a camel's-hair brush, on to the paper. The powder is next transferred to small beaker glasses, and some 2 or 3 c.c. of nitric acid, of 1·2 specific gravity, are added, along with about 10 to 15 drops of concentrated sulphuric acid. The beakers are then placed on a sand-bath, and moderately heated, at first; but when the contents have nearly become dry, the heat is increased, so as to evaporate and expel all sulphuric acid. The beakers should be covered with perforated watch glasses. This operation requires from about three-quarters to one hour. The addition of sulphuric acid is made in order to increase the oxidizing action of the nitric acid, and also to convert any lime which may happen to be present in the ore into a difficultly soluble salt. It is very useful, also, to add some 10 or 20 drops of hydrochloric acid to the mixture of the two acids just alluded to, since the rapidity of the evaporation is thereby increased, and the occasional spirting about of the fluid is lessened.

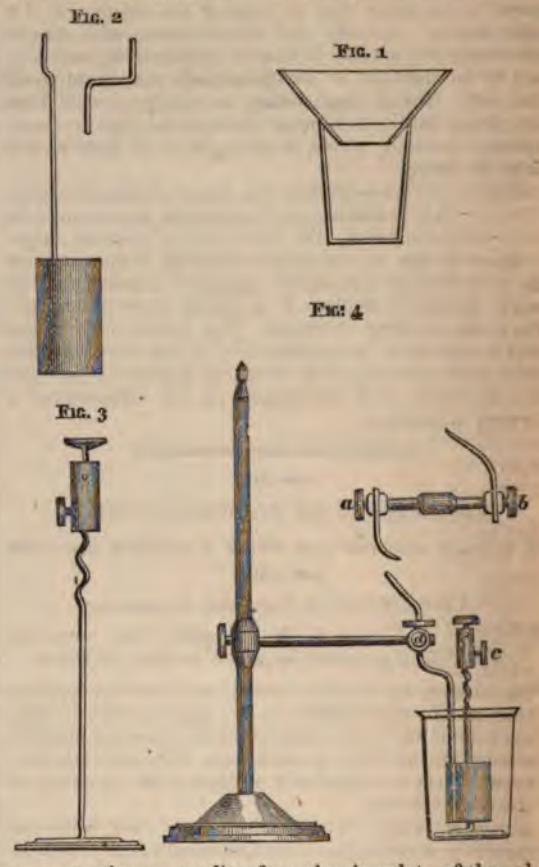
The process just described is modified, of course, first by the use of porcelain capsules, the contents of which are easily transferred to beakers with flat bottoms, and not higher than about 2 inches in all. It is better, also, to use a sulphuric acid, prepared of equal bulks of concentrated acid and water, and to measure off 4 c.c. for each assay; while for each assay, moreover, 6 c.c. of nitric acid, and about 25 drops of hydrochloric acid are taken. Instead of covering the beaker with a perforated watch glass, a funnel is used, as represented in Fig. 1; with this arrangement, the sulphuric acid evaporates far more readily, and loss by spirting is prevented. The beaker is heated on a well-arranged sand-bath.

III. *Precipitation of the Copper.*

As soon as the beaker-glass, after removal from the sand-bath, has become quite cool, the funnel which has been used as a cover is washed on both sides, inner and outer, with nitric acid of 1·2 sp. gr., diluted with six times its bulk of pure water; the sides of the beaker are next likewise washed, and the latter filled to about half its height with the same acid. A few drops of a concentrated solution of tartaric acid are added (which acid, by the bye, is best kept in solution in open vessels, only slightly covered with a piece of paper); this having been done, the wire spiral, represented in Fig. 2, is carefully placed into the beaker-glass. This spiral consists of a piece of platinum wire, about 1-12th of an inch thick, and 7½ inches long, while two-thirds of its length is so wound that the straight end of the wire projects as if it were the axis of the centre of the spiral. The convolutions of the spiral are so large that they touch the sides of the beaker, while the straight portion just touches the centre of the bottom of the vessel.

When the heating has been carefully attended to, the acid fluid added to the contents of the beaker, after evaporation to dryness, will generally be quite clear; if it happens to be turbid, 1 or 2 c.c. of a concentrated solution of nitrate of baryta may be added, and the thorough mixing of this saline solution with the acid contents of the beaker promoted, by gently moving up and down the platinum spiral just alluded to, and allowing the fluid to rest for a few minutes after. The copper present in the mass left at the bottom of the beaker gradually dissolves; and it is not actually requisite to wait for applying the galvanic current until it is all dissolved.

The next point is to place in the beaker the platinum *foil, represented* at Fig. 3, of which the dimensions are—length, 2½ inches; width 1¼ inches. The lower end of this platinum foil should be left about 1-16th of an inch apart from the convolutions of the spiral. When the beaker is only half filled with liquid, the platinum foil is immersed in the same for more than three-fourths of its height. The wire fastened to the said foil is fixed, by means of a screw *a*, to the arm *ab* of the stand, represented at Fig. 4; the other screw, *b*, serves to fasten



a copper wire, proceeding from the zinc plate of the galvanic battery. When the small screw clamp c (Fig. 4) has been fastened to the platinum wire placed in the beaker, another wire is fastened in the top opening of the clamp just referred to, and this wire connected with the copper-plate of the battery, and the galvanic circuit thus closed. In a few moments after this has been done, the platinum foil, bent in the shape of the cylinder and placed inside the beaker, as before described, will be observed to become covered with a coating of metallic copper, while from the platinum wire spiral bubbles of gas escape, which facilitate, to some extent, the solution of the oxide of copper in the dilute acid.

In order to ascertain whether the whole quantity of the copper has been precipitated, some more dilute nitric acid is added to the fluid in the beaker-glass. If, in ten minutes after this, no more metallic copper is separated on the clean portion of the platinum foil, the operation is finished.

It is to be here observed that continued practice has proved that the addition of a concentrated solution of nitrate of baryta acts injuriously on the process, in so far as the metallic copper, which becomes separated,

gets mixed with some insoluble sulphate of baryta, which increases the weight of the substance to be weighed. The cylinder made of platinum foil, should not be at a greater distance from the platinum spiral wire than about 1-16th of an inch.

The time occupied by the complete precipitation of the metal varies according to the force of the galvanic current. It varies in duration from three to even eight hours. In order to make this point certain, all test assays are left for eight hours consecutively, in contact with the galvanic current, experience having proved that, after that lapse of time, even with a weak current, the precipitation was so complete that all chemical reagents, even the most delicate, for detecting copper, failed to discover even the most minute trace of that metal.

IV. *Weighing the Copper.*

According to M. Luckow's plan, the platinum cylinder to which the copper adheres, and the platinum wire spiral are disconnected from the galvanic apparatus, the platinum cylinder carefully removed from the beaker and immediately plunged into a beaker filled with fresh cold water, and rinsed therein; next washed with alcohol, by means of a washing bottle, and then dried in a drying apparatus, and weighed after cooling. Since the platinum cylinder had been very accurately weighed *before* the experiment, its increase in weight will, of course, be that of the copper obtained.

The process here described has been somewhat modified and greatly improved upon at Eisleben, where it is in constant use, by means of a series of galvanic elements. It is, in the first place, found better not to disconnect the galvanic current while yet the copper is in contact with acid, so that, instead thereof, the acid fluid in the beaker is replaced by running in a stream of water, and suffering the same to run over the sides of the beaker, and to be received into a proper vessel to hold it. In this manner all the acid is displaced, without risk of any very small quantity of copper becoming acted upon by the acid during the brief period lapsing between the disconnecting of the galvanic current and the removal from the beaker of the platinum cylinder and spiral wire. These parts, on being removed, are carefully washed, first with boiling water, next with alcohol, and then dried, at a temperature of about the boiling point of water. The cylinder is then weighed, and, after that, the copper coating is removed therefrom, by means of nitric acid; next washed in water, dried, and again weighed.

There are in use at Eisleben nine galvanic batteries (lead and zinc elements); these yield eighteen assays ready for weighing in twenty-four hours. It would be easy for the person there employed to work with twelve batteries, each of three elements. The results obtained are highly satisfactory. The following observations may be made in reference to this method:—

(*a*). The quantity of ore taken for trial is 2 grammes, and is found sufficient, while it consumes less acid.

(*b*). The evaporation of the acid is carried on to complete dryness on the sand-bath. Spirting of the fluid is easily prevented; when the copper has been precipitated properly it will show its peculiar colour on the surface, and the good success of the operation may be judged from the fact, also, that no saline matter adheres to the platinum; the complete absence of which saline matter has been found to be evidence of complete removal of the copper from the fluid.

The process just described is especially applicable and useful for rather poor ores, such as do not contain above 7 or 8 per cent of copper. Each assay, from beginning to end, takes ten hours for complete analysis; but it is evident that the longer portion of this period is such as does not give active employment to the assayer. The expense of working this process, after the apparatus have been once purchased, is very small indeed. The process may be applied to analyse rather rich ores, and also of alloys of copper, with some slight modifications, which require attention, especially, also, if silver should happen to be present.

ON A NEW METHOD OF

ESTIMATING THE REDUCED PHOSPHATES OF LIME, MAGNESIA, IRON, AND ALUMINA,

IN SUPERPHOSPHATES OR MANURES.

BY J. A. CHESSHIRE.

ATTENTION having been called this season to what is termed the going back, or the reduction, of the soluble phosphates into insoluble phosphates, in superphosphates, as an analytical chemist at a manure works in the midland counties (Bradburn & Co., Wednesfield, near Wolverhampton), I have been required to estimate the reduced phosphates so formed. The plan now in use—viz., boiling with citric acid—is, I have found, not to be relied upon, as I have partially dissolved ground coprolite in this acid. The way that I am in the habit of doing is this:

Take about 1½ grammes of superphosphate, extract the soluble part with cold water, and, afterwards, with boiling water; wash the insoluble residue on the filter into a beaker, boil for about half an hour with oxalate of ammonia and about two drops of oxalic acid, so as to have a slight acid reaction; this I do in order to keep the phosphate of magnesia in solution. Then filter; the filtrate contains the phosphates of lime and magnesia, and, perhaps, a little phosphate of iron and alumina. To the filtrate add tartaric acid, ammonia, and the magnesia mixture, weigh the precipitate, and estimate the phosphoric acid as $Ca_3(PO_4)_2$; the insoluble residue on the filter, from the reduced lime and magnesia, wash into a beaker, boil for about one hour with sulphide of ammonium and a few drops of ammonia, filter, &c.; to the filtrate add the magnesia mixture, and calculate the results in the same manner as the reduced phosphates of lime and magnesia.

I may add, that the reduced phosphates so formed are quite equal, in money value, to the soluble phosphates.

ON THE

SOURCE OF FREE HYDROCHLORIC ACID IN THE GASTRIC JUICE.*

BY PROFESSOR E. N. HORSFORD, CAMBRIDGE, U.S.A.

FOLLOWING up the researches of Prout, C. Smidt, Lassaigne, Tiedemann and Gmelin, Berzelius, Blondlot, Claude Bernard, Schwann, and others, the author endeavours to determine how free hydrochloric acid can be secreted from the blood, which is an alkaline fluid. He assumes that in healthy digestion, as a consequence of increased flow of blood to the gastric mucous membrane, and of the normal elasticity of the walls of the

* Abstract of a paper read before the Royal Society, April 15th, 1869

capillaries, there exists in the membrane a condition which is the equivalent of engorgement. Under the pressure which attends this condition, the corpuscles in contact with the walls of the capillaries would discharge a portion of their acid contents, which, with the adjacent plasma, would pass through the walls of the capillaries. This mixture would contain acid phosphates and chlorides.

By pressure and osmosis, a portion of this fluid will pass through the walls of the gastric tubes; and, to determine whether the fluid that goes through contains free hydrochloric acid, the author employed an acid phosphate of lime, of specific gravity 1·117, of a constitution of $3(CaOPO_5)+2PO_5$, with an amount of phosphate of peroxide of iron present as one to twenty-eight of the acid phosphate of lime. The various other solutions employed were the ordinary laboratory reagents.

On adding ammonia in small quantities to the solution of acid phosphate, with alternate agitation, it required several repetitions before the peroxide with its phosphoric acid became a permanent precipitate, and still several more before the precipitate of phosphate of lime became permanent.

The experiments were made with parchment-paper, prepared from German and Swedish filter-paper, as well as with goldbeaters' skin (animal membrane).

He employed acid phosphate of the formula above, with (each by itself) chloride of sodium, chloride of ammonium, chloride of potassium, chloride of calcium, and chloride of magnesium.

The author also experimented with acetate of potassa and acid phosphate of lime.

With all these there was obtained the same kind of evidence of increased acidity on one side, and of increased alkalinity on the other, to wit, the powder thrown down from the mixture of acid phosphate and chloride. What successive additions of ammonia had been required to effect had been accomplished by dialysis.

The same effect took place from a mixture of acid phosphate of soda and chloride of calcium.

It follows from the above, if these experiments fairly represent the case, and from the known composition of the blood, its condition in the walls of the stomach, and the structure of the gastric tubules, that free or uncombined hydrochloric acid must find its way into the bottoms of the gastric tubules, and thence into the cavity of the stomach.

The secretion of hydrochloric acid is mixed with acid phosphates and alkaline chlorides.

The author therefore states that, whatever other peculiarities the blood corpuscles may possess, they have the requisites for furnishing acid phosphates in solution under pressure, such as must attend engorgement of the capillaries in the walls of the stomach; that, in all probability, as the acid fluid enters the gastric tubules, they are surrounded by a mixture of hydrochloric acid, acid salts, neutral salts, and albumenoid bodies. Dialysis must be repeated, and a stronger acid solution pass into these sacs. The sacs, swelling by endosmosis, and corroded by the acid, must at length burst, and the liquid contents, together with the disintegrated and partially digested membrane of the sacs, pass out into the stomach, to constitute the gastric juice; the free hydrochloric acid, acid phosphates and chlorides, and the albumenoid bodies and disintegrated tissue (*the pepsine?*) to act in the liquefaction *of food.*

ON A CERTAIN

EXCRETION OF CARBONIC ACID BY LIVING PLANTS.*

BY J. BROUGHTON, B.SC., F.C.S.,

CHEMIST TO THE CINCHONA PLANTATIONS OF THE MADRAS GOVERNMENT.

While the author was engaged in some experimental determinations of the changes that take place in the composition of the Cinchona barks after being taken from the tree, he noticed a somewhat singular circumstance, which induced him to institute a series of experiments, by which he discovered that the various parts of living plants excrete carbonic acid, not only in their normal condition, but after they have been deprived for days together of all access of oxygen. The experiments were mostly made on cut portions of the plants, but experiments were also made for control on plants as they actually grow. The deprivation of oxygen was effected sometimes by Sprengel's air pump, sometimes by substituting for air an atmosphere of hydrogen or nitrogen, while comparative experiments were made on plants supplied with air that had been freed from carbonic acid. The main conclusions to which he was led are those enunciated by the author:—

1st. That nearly all parts of growing plants evolve carbonic acid in considerable quantities, quite independently of direct oxidation.

2nd. That this evolution is connected with the life of the plant.

3rd. That it is due to two causes, namely, to previous oxidation, resulting after a lapse of time in the production of carbonic acid, and to the separation of carbonic acid from the proximate principles of the plant while undergoing the chemical changes incident to plant-growth.

THE

ELLERSHAUSEN PROCESS OF REFINING IRON.

The recent invention of Mr. Ellershausen, which is now regularly in use in Pittsburg, Pa., and is being rapidly introduced all over the country, has greatly advanced the solution of the problem of cheap iron.

The process consists in the conversion of crude cast-iron, as it runs from the smelting furnace, into wrought-iron, by the simple admixture of pulverised iron ore. It is carried out at the works of Messrs. Shoenberger, at Pittsburg, in the following manner:—On the casting floor of the smelting furnace, a cast-iron turn-table, about 18 feet diameter, is revolved on rollers by a small steam-engine. Upon the outside edge of the table stand a row of cast-iron partitions, forming boxes, say, 20 inches wide and 10 inches high, open at the top. Just above the circle of boxes stands a stationary, wide-mouthed spout, terminating in the tap-hole of the furnace. When the furnace is tapped the liquid iron runs down this spout, and falls out of it in a thin stream into the boxes as they slowly revolve under it, depositing in each a film of iron say one-eighth of an inch thick. But before the fall of melted iron reaches the boxes it is intercepted, or rather crossed, at right angles, by a thin fall of pulverised iron ore, which also runs out of a wide spout from a reservoir above. These two streams or falls are of about equal volume, say one-quarter of an inch deep and 20 inches wide. A workman, with a bar

* Abstract of a paper read before the Royal Society, April 28th, 1869.

in the tap-hole, regulates the stream of iron, and the iron spout from which the liquid metal falls into the boxes is removable; other spouts, previously coated with loam and dried, being attached to a common revolving frame, so as to be ready for use when the loam covering of the first becomes cracked or removed.

The thin layers of iron and ore soon chill and solidify, so that by taking away the outer partition of the boxes (which form the rim of the turn-table) they may be removed in cakes of the size of the boxes and weighing about 200 pounds each. Four of these cakes or blooms are put into a reverberatory puddling or heating furnace, and raised to a bright yellow heat. They will not melt at this heat, but become softened so as to be easily broken up with a bar. The four blooms are formed in the furnace by the "rabble" of the workmen, as in ordinary puddling operations, into eight balls. The balls are brought out one after another, squeezed in the ordinary "squeezers" to expel the cinder and superfluous ore, and then rolled into wrought-iron bars, which are now ready for market, or for further reduction into smaller finished forms.

The chemistry of the operation is as follows:—The crude cast-iron contains, say, 5 per cent of carbon, and 2 per cent of silicon, and more or less sulphur, phosphorus, and other impurities. In the Bessemer process the oxygen of the air, blown into the liquid iron, combines with this carbon and these other impurities, and not only removes them but leaves the pure iron in a liquid state, from which it can be cast into homogeneous masses of any size. In the puddling process, the oxygen of the air and of the ore or other "fettling" put into the furnace with the iron combines with and eliminates the impurities, which are afterwards squeezed out of the pasty mass by the squeezers and rolls. This process is long and comparatively expensive, because the mixture of oxygen or oxygen-bearing substances is not made intimate with the iron except by long stirring, which is not only skilful but exhausting work.

In the Ellershausen process the oxygen of the ore or oxide of iron (manganesic oxide is preferred) combines with the carbon and impurities, eliminating them as in the puddling process, and the iron of the ore increases the product. The chemical combination of the ore and the liquid crude iron appears to take place partly at the time of their contact when falling and lying upon the turn-table, and partly where the re-heating occurs in the furnace. It seems impossible that a reaction which is so violent in the Bessemer process, and so prolonged in puddling, should take place so quickly and quietly in the new process, but the fact that the cakes of iron and ore do not melt by subsequent heating, as cast-iron would, proves that its nature is changed by the first contact of the ore. The removal of sulphur and of phosphorus also seems more thorough than in the other processes. Analyses at different stages of the operation will throw more light on this question.

The remarkable feature of the Ellershausen process is that absolutely no skill is required to carry it out. The proportion of ore mixed is intended to be about 30 per cent, but if too much is added, it is readily squeezed out with the slag, and seems to do no harm. The subsequent heating occupies about half an hour. "Puddle-bar," the product obtained from the first rolling of the product of the puddling furnace, is never marketable or finished iron. It is usually very ragged and unsound, and requires subsequent piling, re-heating, and re-rolling, to expel the impurities, and to give it soundness and solidity. The new process appears to produce merchantable iron at the first rolling, and at Pittsburg, from a very inferior pig-iron made of one-half sulphurous Canada ores, and one-quarter Lake Superior and one-quarter Iron Mountain ores.

The thoroughness and rapidity of the purification by this process evidently depend on the intimacy of the mixture of iron and ore. This intimate mixture is also the essence of the Bessemer process. In fact, to Mr. Bessemer's original apprehension of this idea of intimate mechanical mixture the greatest modern improvements in the iron manufacture are due.

The Ellershausen process is said to decrease the cost of wrought-iron from 10 dollars to 20 or 30 dollars per ton, according to the materials used and the form of the product required. That it is a success is amply proved by regular working at Pittsburg and many experiments elsewhere.—*American Artisan.*

DR. LETHEBY

ON THE

METHODS OF WATER-ANALYSIS AND ON SEWAGE CONTAMINATION.

A few weeks ago Dr. Letheby read a very important paper to the Metropolitan Association of Medical Officers of Health, entitled "On the Methods of Estimating Nitrogenous Matters in Potable Waters, and on the Value of the Expression 'Previous Sewage Contamination,' as used by the Registrar-General in his Monthly Reports of the Metropolitan Waters." The discussion which followed it was very animated, and was so long that an adjournment for a fortnight was found necessary. In this interesting paper, Dr. Letheby attacked with great warmth the methods of analysis employed by Dr. Frankland, the deductions which the latter chemist thinks himself justified in making from the results of his analysis, and in particular the well-known calculation of "previous sewage contamination" from the nitrogen found as nitrates, nitrites, and ammonia in the water. He described the methods in which he himself places reliance—methods which need not be recapitulated here because they are familiar to almost all chemists—and in contrast with them recited a formidable list of the difficulties and errors to which, he asserted, Frankland and Armstrong's methods were liable. This part of the subject, important though it be to chemists, we do not propose to discuss in any detail at the present time, reserving it, if need be, for a separate consideration hereafter. The combustion process, by which Dr. Frankland estimates the organic carbon and nitrogen of a water, is, to judge from the trial experiments, very greatly more accurate than any that has hitherto been suggested for the determination of organic matter. Both the absolute and percentage errors observed in the trial experiments were, indeed, marvellously small, considering the extraordinary difficulties to be encountered. Dr. Letheby appears to rely mainly upon the permanganate test, and calculates the amount of organic matter in the water by multiplying the oxygen-indication by eight. This calculation is founded on a comparison between the indications of the test and those of the old incineration method; but as the latter has long been known to be worthless, and as Dr. Letheby himself has abandoned its use, it is difficult to see how the calculation can give even an approximation to correctness. Every one of our readers is, moreover, aware that the oxidising power of the permanganate varies extremely in different cases; that of nine kinds of organic matter

examined by Frankland and Armstrong, one—viz., oxalic acid—was completely oxidised by it, even in six hours; that urea, hippuric acid, and creatin were scarcely oxidised at all, while the mineral, sodic nitrite, was oxidised instantaneously.

These considerations are, however, somewhat irrelevant upon the present occasion, for Dr. Letheby does not seriously impugn the accuracy of the method by which Frankland and Armstrong effected the determination of the nitrogen present as nitrates and nitrites, and agrees with the latter chemists in employing the Nessler test for the determination of ammonia. It is from these compounds that the previous sewage contamination is calculated, and it is to this calculation that the criticism of Dr. Letheby is mainly directed. The ammonia present in potable waters is generally a small quantity, and we may therefore assume, for the purpose of the present discussion, that the previous sewage contamination is entirely deduced from the nitrates and nitrites of the water. Dr. Letheby does, indeed, impugn the accuracy of the correction made by Dr. Frankland for the nitrogen introduced by rain; but this makes little real difference, for even if the estimate of Lawes, Gilbert, and Way be adopted, and the river be assumed to contain the whole quantity of combined nitrogen found by those chemists in the rain of Rothamstead, without a grain having been removed by vegetation, the deduction would only be equal to 985 parts in 100,000 of previous sewage contamination, instead of 320, a difference equal to less than one-fifth of the amount frequently attributed to some of the London waters in the Registrar-General's returns.

Divested in this manner of collateral issues, the arguments of Dr. Letheby may be reduced to a few simple propositions. He maintains, in the first place, that the nitrates and nitrites of potable waters are not due solely to the oxidation of animal matters, but are frequently derived from other sources, and that therefore it is fallacious to use them as a measure of previous animal contamination. Under any circumstances, moreover, they could not be an accurate measure, because the process of vegetation is constantly removing them from waters exposed to its action, and it consequently happens that waters known to have received sewage contamination are sometimes found to contain scarcely any oxidised nitrogen, while others which, it is alleged, cannot have received any such contaminations contain much. A good illustration of this apparent anomaly was quoted by Dr. Letheby. In the months of July, August, and September, 1868, the water supplied by the Kent Company, and derived by them from deep chalk wells, was described by the Registrar-General as exhibiting a previous sewage contamination of 3660, 3660, and 3530 parts in 100,000; while that of the East London Company, derived from the sewage-contaminated Lea, was returned for the same months as 0, 0, and 20.

It is furthermore urged by Dr. Letheby that it is unfair to describe by a name calculated to produce disgust and alarm, a contamination which, whatever its source, has been oxidised and rendered innocuous in the water. Sewage diluted with twenty parts of water is, he asserts, entirely destroyed in the course of a run of ten or twelve miles down a river, and it is therefore impossible for mischief to arise from the drinking of such water.

To these various hostile criticisms, cogent replies have been produced. Dr. Frankland argues upon the first point, that, after the most diligent search, he has failed to discover the slightest evidence of the formation of nitrates from vegetable matters. Whenever nitrates are found in England or abroad, they can be traced generally with the utmost ease, to animal sources, and whenever such sources are absent, nitrates are absent too, although considerable quantities of combined nitrogen may be present. It would be a wonderful thing if the water of the chalk wells did not frequently contain nitrates, considering that it is derived by percolation from the sewage and manure-stained soil above. In the case of the chalk water supplied to London, the probability of direct sewage contamination is peculiarly great, for the great fault in the chalk, from which the Kent Company on one side of the river and the South Essex Company on the other, derives so large a supply of water, passes directly under the foulest part of the Thames. Dr. Frankland admits most fully that the calculation of sewage contamination is only an approximate one. In proportion as the nitrates have been removed by vegetation in streams or reservoirs, the calculation will, of course, be too low. All that he pretends to do is to show the *minimum* contamination which can have occurred, and he points out that injustice cannot be done to the water companies because he can never exaggerate, and very frequently understates, the previous pollution of their water. It is of course true that animal contaminations of all kinds have to be reckoned in terms of London sewage. The phrase to which Dr. Letheby so much objects is by no means intended to signify that the contamination has in all cases been the actual sewage of towns. All such contaminations are objectionable in the highest degree, and there can surely be no harm in referring them to so suitable a standard as the one selected. It is employed for the comparison of different animal contaminations, just as physiologists compare different kinds of food by their *starch-equivalent*, without intending to assert that all kinds of food consist of starch; and it must not be forgotten that as applied to the greater part of the water supplied to London and other towns, the phrase simply states an indubitable fact.

Finally, we may observe that the self-purifying power of running water is doubted by no one, least of all by Dr. Frankland, who founds his calculation of previous sewage upon his study of it. But the absolute statement made by Dr. Letheby in regard to it—the sharp line which he draws to fix the complete purification of the water—is liable to considerable doubt. Dr. Frankland, Sir Benjamin Brodie, and many other chemists believe the process to be much less uniform and rapid than it has generally been supposed to be, and that, under certain circumstances, it is even almost inoperative; but if their views were entirely erroneous, it would be none the less incumbent upon Dr. Letheby to prove his statement. We know as an absolute fact that tons upon tons of human excrement are thrown into the waters of the Thames and Lea before we drink them, and we have a right to look for absolute demonstration of the complete destruction of all this filth; and not only of the filth itself—of the lifeless organic matter;—we must also be convinced that it is impossible, at all times and under all circumstances, for living matter—the low forms of life and their germs with which the processes of disease and putrefaction appear to be so closely connected—to retain their vitality under the conditions assigned by Dr. Letheby, before we can be content to accept his statement, or can learn to look with indifference upon previous sewage contamination.

It is, we trust, no discourtesy to say that the chemical methods heretofore employed appear inadequate for such a proof. The noxious matters of a water are probably beyond the reach of the test tube and the balance. They belong, in all probability, to that inscrutable class in

which the virus of small-pox and cattle plague must be reckoned. That they would resist the oxidising action of the water longer than mere chemical compounds, can hardly be doubted, and, indeed, it has yet to be demonstrated that the dissolved oxygen of the water has any greater destroying effect upon them than it has upon the fishes which inhabit the same streams.

ALKALI WORKS.

We inserted last week a letter from an alkali manufacturer, urging that if alkali makers comply with the "Alkali Act," no farmers or other persons ought to be allowed to complain. This is a bold position. He forgets that the Alkali Act controls one gas only. We suppose he is an Englishman, and yet he wishes to take from his countrymen the right of grumbling—the right of petition and complaint. We doubt if Parliament, with all its power in this respect, can interfere. Besides, the Alkali Act does not demand perfection from the manufacturers. It was established to diminish an evil in such a manner that it should not hurt the manufacturers; but it did not attempt to decide whether the 5 per cent of muriatic acid allowed to escape could under any circumstances injure any person. We know that coal smoke will damage plants, because of the sulphurous acid in it, small as it is; we conclude, therefore, with certainty, that any addition of acid will injure them yet more; and 5 per cent of escape from an alkali works may probably injure in cases where the total amount given out is great and the fields readily struck.

Admitting that an alkali maker is very far from infringing the Alkali Act, is he always equally innocent of doing mischief by gases not mentioned in it? Weight for weight sulphuric acid is in reality more dangerous to plants than muriatic acid. It is extremely heavy, and a little does much evil, because it does not readily disperse. Now, do the alkali makers and sulphuric acid makers keep all their fumes to themselves? We have no information as to the alkali makers, but we have heard of a man, not an alkali maker, who lets go 20 per cent of his sulphuric acid. We enquire of the Inspector of Alkali Works, and what does he say?—He is very sorry, but he has no right to interfere, or even to enter the works. If he were asked his opinion of such a work—supposing it were also an alkali work—he would say that, so far as he is concerned, he can find no official fault; and this would be a work complying with the Alkali Act, and yet worse than farmers even imagine.

Some people may think we are talking loosely, and that, as it is the interest of a manufacturer to keep his acid, they may venture to assert such prodigality is impossible. This kind of argument is very common; so far as chemical works are concerned, however, it does not hold good: people do act against their own interests. Do we not know in the abstract that all evil is against the true interest of man, but it does not therefore cease?

We hope we have said enough to show that the Alkali Act is not sufficient to protect the farmers even from alkali works; and what shall we say of copper works, sending out their 100 per cent of sulphurous and sulphuric acid in clouds that dull the sky for miles; of chlorine, of nitrous gases, of sulphuretted hydrogen, and of fluorine compounds? The Alkali Act regards only one of the noxious gases; and the question may be put—Shall it be extended to more? In some places its influence can be but small, because so many other gases interfere. But, even when they do not interfere, is it not true that an escape of muriatic acid may come, and, in a few hours, destroy the labour of months? Is this just in the alkali makers? Of course, all are not to be blamed for this, nor are all believed to allow any sulphuric acid to escape, but we say it because, as a rule, the farmer has ground for complaint as well as the alkali maker. We do not, however, entirely take the farmer's side; by no means: we know of men who could not stay at a farm when the alkali works were given up; and the greediness of human nature constrains us to doubt if the manufacturers are quite justly treated by the farmers.

"An Interested Person" asks if a scientific legal court ought not to be constituted. Trials for nuisances are generally very unsatisfactory. There is no authorised person to put down the daring assertions made by some men. We have heard one say that sulphuretted hydrogen did no harm to human beings, and the judge could not contradict. Not long ago, we heard of a witness who said that the gases complained of were a mixture of sulphurous acid, chlorine, and sulphuretted hydrogen! Now, no judges are even expected to know that these gases cannot exist together, and, with one or two exceptions, barristers do not know. If a chemist happen to be present, he may get a pertinent question put, but if not very determined, he may find a difficulty, and many would rather let the case go to wreck than be put to the discomfort of asserting their knowledge amidst the unpleasant badgering of a public court. The greater number of the questions arising at a trial would be settled by men who had very simple notions of justice if only the facts were well known.

Would a scientific court do the work better? It was purposed that the Inspector should have most of the gases under his view, and should be allowed to settle questions which involved claims such as are brought to a County Court. We do not pretend to decide, and should be unwilling to lay claim in favour of scientific men to the prejudice of such an important body as men of law. We believe that it would be better for both parties if the facts of the case were probed more fully by a chemical mind. Scientific men cannot expect to adjudicate so clearly in vexed questions as the legal profession, which has struggled since civilisation began to put in order the varied activities of the human race, which yearly invents new crimes and makes room for new virtues. Perhaps "An Interested Person" may, on further consideration, think his view of this question not quite adequate.

ON A METHOD OF MAKING

RAPID DETERMINATIONS OF FREE OXYGEN.

BY P. HART.

The apparatus required consists, in addition to an ordinary pneumatic trough, of two tubes each half-inch diameter and 16 inches long, closed at one end. One of the tubes is graduated into 50ths of a cubic inch, and the other is coated internally with phosphorus. This is effected by dropping into the tube a few pieces of phosphorus; it is then to be closed by a sound cork, and the phosphorus (melted by immersing the tube in hot water) may be spread in a thin coating over the interior by turning it round as it cools. On cooling, the cork is to be withdrawn, the tube filled with water, and a piece

of india-rubber tube tied securely over the mouth. This completes the apparatus.

Modus Operandi.—Both tubes are filled with water and allowed to remain in the trough, a portion of the air to be examined is passed into the measuring tube, which is now allowed to remain for five minutes in the trough to allow it to attain the same temperature as the water. It is lifted until the water is at the same level within and without, and may then be closed by the finger, and withdrawn from the trough. The volume is easily noted. This done, it is connected by the india-rubber joint with the phosphorus tube, into which the air is allowed to flow. The whole may now be placed for half an hour in the trough, when the gas may be poured back into the measuring tube, the level once more taken, and the volume read off in the same way as before. The loss is oxygen.

a. Measuring tube.
b. India-rubber junction.
c. Phosphorus tube.

No claim is made for strict scientific accuracy in connection with this apparatus; its sole merit consists in its offering an easy and rapid means of approximately determining the free oxygen in an atmosphere. In the working of sulphuric acid chambers it has been found extremely valuable, and possibly may be found so for other technical enquiries.

REMARKS ON THE ESTIMATION OF COPPER IN ORES.

BY FREDERICK FIELD, F.R.SS. L. AND E.

THERE is a detailed account in the CHEMICAL NEWS (Nos. 489 and 491; *Am. Repr., June*, 1869) of certain methods for the estimation of copper in ores, for which a premium has been awarded. The paper also contains some valuable observations by Dr. Steinbeck on the volumetric determination of copper by means of cyanide of potassium, known generally in England as Parkes's method. Dr. Steinbeck gives us the results of his experiments, which prove that, in order to estimate the metal correctly, care must be taken to avoid great excess of ammonia, or its salts, as these exercise a very disturbing influence. The Dr. has also paid considerable attention to the influence which other metals exert when in combination with the copper, and finds that lead does not interfere in any way with the valuation of the former. He recommends the thorough washing away of the salts of zinc from the precipitated copper, previous to its solution in nitric acid, as the presence of that metal would greatly interfere in the estimation of the copper.

The writer is able most fully to confirm the above statements, from the lengthened experience he has had in South America in the estimation of copper in ores, slags, etc., many thousands of assays having been performed by Parkes's method; but there are other metals, not mentioned in Dr. Steinbeck's report, which frequently occur associated with copper, and would also be precipitated upon the zinc, together with that metal. Arsenic is, perhaps, the one most generally found; and, from many careful experiments, it has been satisfactorily proved that it exerts no influence whatever upon the correctness of the method. The same may be said of *both tin and antimony.*

It can be easily imagined that the metals whose oxides are soluble in ammonia would interfere with the amount of alkaline cyanide necessary to remove the colour from an ammoniacal solution of a known weight of pure copper, seeing that a portion of the cyanogen is devoted to the other metals, as well as to the copper itself. This is, of course, the case with silver, zinc, nickel, and cobalt; the two first metals forming double cupro-cyanides of great beauty and interest; and it can also be well understood that *more* cyanide is required in these instances than with copper *per se.*

But the writer has shown (CHEMICAL NEWS, vol. i., p. 26, *Eng. Ed.*) that, in the case of manganese, the result is entirely different, the solution of the two metals requiring *less* cyanide than copper would for its decolourisation. For instance, 10 grains of electrotype copper were brought into solution with 20 grains of sulphate of manganese, and a known weight of ammonia and chloride of ammonium added. The cyanide of potassium contained in 85 divisions of the burette was found sufficient* to decolourise the liquid; while 100 divisions were requisite for ten grains of copper without manganese, treated under precisely similar circumstances.

The writer would be very glad if some one of the numerous readers of the CHEMICAL NEWS would explain this fact, which he confesses appears to him somewhat difficult.

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.†

BY EDWARD C. C. STANFORD, F.C.S.

OUR great object is to consider, first, how to carry away from our houses the excreta of our large population; and secondly, how to treat it so as to recover for our use its full fertilising value. The peculiar character of the material to be dealt with renders some vehicle necessary for its transport.

This vehicle may be either solid, liquid, or gaseous; and the secondary proposition depends so entirely upon the vehicle employed for the first, that I intend briefly to review these three several means of conveyance in their chemical aspect. To avoid complication in speaking of either, I shall assume the general adoption of solid vehicles, the cheapest being earth, of liquids water, and of gases air; I shall speak of the three different methods as water, earth, and air carriage, taking water first, as being now most common.

I wish to premise, however, that I regard both the above propositions as essential and necessary; and take as my text Mr. F. O. Ward's celebrated formula—"The rainfall to the river, and the sewage to the soil,"—no system of sewerage is worthy our consideration which does not give back to the soil that which in our food we have taken from it; and I consider the mere ridding ourselves of a valuable fertiliser, simply on account of difficulty in dealing with it, quite beneath the enlightened spirit of our age.

For convenience of calculation, I take the population of Glasgow at 500,000, and the value of the excreta at 8s. 4d. per head per annum, or £208,333. This is the value given by Professor Way and Mr. Lawes (the highest authorities on this subject), in the third report of

* On the addition of Liebig's cyanide of potassium to an ammoniacal solution of the oxides of manganese and copper, a certain portion of the former is precipitated. It might be imagined that this precipitate dragged a portion of the copper with it out of solution; this is, however, not the case; the precipitates in many instances having been carefully examined for that metal.

† Read before the Glasgow Sewage Association, March 30th, 1869.

the Sewage Commission, and it is now generally adopted by all chemists, each person being reckoned as contributing the value of 12½ lbs. of ammonia per annum.

The total bulk of excreta, making allowance for loss, is estimated at 10 cubic feet per head per annum, and its weight 630 lbs., making an annual total of 5,000,000 cubic feet, weighing 140,625 tons; or, per day, 13,698 cubic feet, or 385 tons.

This, then, is what Glasgow has to remove. The value is 10d. per cubic foot, or 29s. 6d. per ton, and equal (Professor Way) to 16,666 tons of Peruvian guano annually. Of this amount the solids form 1-10th, and the liquids 9-10ths; or 1 cubic foot per head per annum solid, and 9 cubic feet of liquid. The solid and liquid excreta have a relative chemical value of 1 to 6, or 1s. 2d. per head for the former, and 7s. 2d. per head for the latter. The total is thus divided:—

	Tons.	s. d.	£
Annual value of solid excreta..	14,062 at	41 5 ..	29,161
" " liquid " ..	126,563 "	28 3 ..	179,172
			£208,333
The value of the daily removals is	385 "	29 6 ..	£569

Let us see how this is proposed to be removed, and what is to be gained in the process.

WATER CARRIAGE.

Taking the amount of water used per head at 5 cubic feet daily, and the rainfall the same, we have the 10 cubic feet diluted with 3,650 of water, and the annual material to be removed increased from 500,000,000 cubic feet to 1,825,000,000 cubic feet, or 140,625 tons increased to 50,920,401 tons; in other words, we require daily to pump away 140,000 tons of sewage to remove 385 tons of excreta, of which only 38½ tons is solid matter. No wonder we are called upon for lavish expenditure to carry off such a quantity as this, for even if no pumping were required, the cost for sewers must be enormous. And then does it carry it away?—and does it utilise it? Suppose an elaborate system of intercepting sewers to convey our sewage to some point several miles down the river; would that meet the evil? Let the experience of London answer this. The metropolitan sewage works are the greatest effort of this kind, and, from the difficulties overcome, are a perfect triumph of our engineering skill, reflecting the highest honour on Mr. Bazalgette; but they cost the princely sum of £4,250,000, or £180,262 per annum, the cost to be paid off in forty years by rating, at the end of which period the Thames will probably be closed as a port by their deposit, the sewer gases will have proved themselves the most deadly of enemies, and London will stand on a substratum of soil loaded with sewage from infiltration and leakage.

To show that these are not improbable speculations, I append an extract from an able article in the *Pall Mall Gazette* of February 26, 1868, entitled "The Sanitary Dead-Lock":—

"It has now been decided that although Parliament has conferred the right of drainage into the sea and public rivers, this right can only be exercised subject to the condition that no other nuisance is thereby created. 'The notion of collecting all the sewage of a large town,' says Vice-Chancellor Wood, in the case of Blackburn, 'and pouring it into a river without the slightest attempt to clear it of any of its grossest materials, is simply monstrous.' And, again, in the Attorney-General *v.* Birmingham Town Council, the court went as far as to declare that it would not balance the convenience of a town against the legal rights of an individual complainant—the latter must be respected. . . . . The case of the metropolis differs from that of the provincial towns, but has occasioned a similar sanitary dead-lock. The main-drainage system discharges the refuse of London into the Thames at Barking and Crossness, comparatively out of the way of population. Although there is, therefore, no sanitary objection to these works, except as regards the towns below London, such as Barking, North Woolwich, Greenwich, Erith, &c., a serious difficulty of another kind has arisen. The mass of matter daily washed down by the sewers of London is so great that, during the few years that have elapsed since the opening of the new sewers, an enormous concentrated deposit of mud, street sweepings, and sewerage refuse has accumulated in the bed of the river at Barking and Crossness, and now obstructs the navigation of the river. Last November Mr. Cave stated in the House of Commons that a ship had already stranded on one of the banks thus formed. A chart of the bed of the river at Barking, which has recently been prepared, shows that in the very centre of the channel the soundings have diminished at low water from 21 to 10 feet. . . . Whatever may be the legal aspect of the question, it is quite evident that the navigation of the Thames cannot be allowed to be obstructed even for the sake of draining the metropolis, and that legislative interference will be required if the existing Acts are at all doubtful on this point. Indeed, the whole subject demands the careful consideration of Parliament, in order to release the municipal authorities throughout England from the embarrassing position in which they are now placed. Some way must be discovered of draining our towns at a less sacrifice than is involved in the pollution of streams and blocking up of navigable rivers."

And as to the sewer gases, it appears, according to the evidence collected by the sewage commission, quite impossible to get rid of them; one of the engineers examined making this terribly suggestive answer:—"I am afraid we must let out the stink in the middle of the streets."

Now stink is not the word, for sewer gases are gases of decomposition, and carry malaria, pestilence, and death with them. Dr. Fergus has related one of many instances in which a number of houses at Leith, previously healthy, have been affected at once with gastric (or typhoid) fever, when connected with the sewers; and showing the constant infiltration of sewage into the soil, and thence into wells; he has also pointed out cases of gastric fever where the long unsuspected cause was the drinking of the water so contaminated.

Mr. Bazalgette states, that to ventilate the London sewers by air would cost £460,000 in plant, and £201,480 annually for fuel alone, exclusive of labour and other expenses; he also states that to flush them with water would cost £383,250 annually, even if the waterworks could supply the quantity, which is out of the question. The water-closet system is also open to great objection—the best constructed closet is seldom perfectly free from odour; the back rush of deadly gases up the sewers when a high tide covers them, or a strong gale blows into their outlets at low tide, is of enormous force, and will rise through any closet, however well trapped.

Water is a mere carrier, and no disinfectant; its cost, also, from the great quantity required, is very considerable. Mr. Smith has stated the cost here at £40,000 per annum, and, no doubt, if general, £50,000 at least

[English Edition, Vol. XIX., No. 495, page 254.]

would be required to provide the water and keep up the closets.

The whole system of sewerage by water-carriage is recklessly extravagant; it carries the solid and liquid excreta down to our neighbours to rot at their doors, and it leaves us a legacy of deadly gases to remind us that our endeavour to cheat nature has signally failed. As applied to even ridding ourselves of the nuisance, it is the finest effort of "the circumlocution office," and the best illustration of "how not to do it," in our generation.

Engineers have employed an elephant to do the work of a mouse, and the burly brute has trodden down and has laid waste the country.

Then, as to its utilisation; here the system almost entirely breaks down. Notwithstanding numerous attempts, no portable manure ever has been, or ever will be, made out of sewage. The chemical value of average sewage, if it could be extracted, is 1d. per ton, taken at 4 grains ammonia to the gallon; this value is deduced from 93 analyses of Rugby sewage by Professor Way, and now generally admitted. One thousand tons are equal to 12 cwts. Peruvian guano.

Much has been said here about the solid matter deposited from sewage by standing; let it be clearly understood that it is almost valueless. At Birmingham it accumulates in large quantity, and cannot be sold at 6d. per ton. The reason of this is obvious; almost the entire manurial constituents are soluble in water; and no wonder all companies looking amongst the deposit for their dividends have failed to find them. They are exactly in the position of a ferret, watching patiently one end of a rat hole while the rat has escaped by the other.

The report of the sewage commission gives abundant evidence that even sewage irrigation only pays in certain favourable circumstances. This report is full of information, and represents an enormous amount of labour by its learned authors. They have worked hard to pick out the grain of wheat from the sack of chaff; but we must all admit that it would have saved them much trouble if we had never allowed the admixture.

Irrigation, the only method of utilising sewage, puts an amount of money value on the ground out of all proportion to the return obtained by the ratepayers. There appears no doubt that the farmer will not give ½d. per ton for it, delivered free of expense. Where gravitation and open carriers can be employed without pumping, its application is remunerative; but in no case is anything like the full money value obtained to the ratepayer. The cost of transport, where the chemical value of a product is only 1d. per ton, is far the more important item.

According to Professor Way's estimate, Glasgow would requre 10,000 acres, constantly in use, at 5,000 tons sewage per acre per annum, and it would really require 15,000 acres, as one-third must be under root crop.

Now, in a damp climate like ours, what land would take this extra amount of water? and what farmer would ever dream of top-dressing his grass with manure equal to 3 tons of Peruvian guano per acre, if he had to pay the full market value for the manure? Moreover, what could be done with the grass where, as in our case, it would be impossible to make it into hay?

This system of sewage by water carriage is, however, now so general, that any means of modifying its *evils may be worth our notice.*

The sewer traps shall all be provided with sieves of charcoal; and I propose to avoid the unsuspected dangers of the sewer gases rising in our present water-closets, to employ a double sieve of wire gauze, containing charcoal, which will slide in just under the seat, and completely close the opening, and which, by a little mechanism, can be made to slide back automatically. Or to enclose the charcoal in a small box with wire gauze sides, and simply place it in the closet. I employ, by preference, seaweed charcoal, the use of which I propose also for the filtration of town sewage, before it is allowed to pass into rivers. It is singularly allied to animal charcoal, which it excels in its porosity, its high oxidizing power, and in the ease with which it admits the rapid passage of thick liquids. The thickest sewage passes through perfectly odourless and colourless. It entirely removes the organic matter from ordinary sewage, and can be used for a considerable length of time, without change. To gain its full power, the sewage should be run into large tanks, which can be used alternately; it is here allowed to deposit for 24 hours. The filtration should be upwards, through a stratum of char, and, when the deposit rises to the char, the whole should be mixed together, and made into manure; the char mixed with the sludge would render it more easy of transport. I do not intend to imply that the char removes the manurial value of the sewage to any great extent, but it renders it innocuous.

(To be continued.)

REPORTS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Annual Meeting, Saturday, May 1st, 1869.

Sir Henry Holland, Bart., M.D., D.C.L., F.R.S., *President, in the Chair.*

The Annual Report of the Committee of Visitors for the year 1868 was read and adopted.

The books and pamphlets presented in 1868 amounted to 116 volumes, making, with those purchased by the managers, a total of 220 volumes added to the library in the year, exclusive of periodicals.

Fifty new Members were elected in 1867.

Sixty lectures and twenty evening discourses were delivered during the year 1868.

Thanks were voted to the President, Treasurer, and Secretary, to the Committees of Managers and Visitors, and to the Professors, for their services to the Institution during the past year.

The following gentlemen were unanimously elected as officers for the ensuing year:—

President—Sir Henry Holland, Bart., M.D., D.C.L., F.R.S.

Treasurer—William Spottiswoode, Esq., M.A., F.R.S.

Secretary—Henry Bence Jones, M.A., M.D., F.R.S.

Managers—George Berkley, Esq., C.E.; William Bowman, Esq., F.R.C.S., F.R.S.; Charles Brooke, Esq., M.A., F.R.S.; George Busk, Esq., F.R.C.S., F.R.S.; Adm. Sir Henry John Codrington, K.C.B.; Warren De la Rue, Esq., Ph.D., F.R.S.; John Peter Gassiot, Esq., F.R.S.; John Hall Gladstone, Esq., Ph.D., F.R.S.; Wm. Robert Grove, Esq., M.A., Q.C., F.R.S.; George Macilwain, Esq.; The Duke of Northumberland; William Frederick Pollock, Esq., M.A.; Robert P. Roupell, Esq., M.A., Q.C.; The Hon. John William Strutt; Colonel Philip James Yorke, F.R.S.

Visitors—Andrew Whyte Barclay, M.D.; Charles Beevor, Esq., F.R.C.S.; John Charles Burgoyne, Esq.; Sir C. Wentworth Dilke, Bart.; Alfred Gutteres Henriques, Esq.; Sir Thomas Henry; Thomas Hyde Hills, Esq.; Thomas Lee, Esq.; William Longman, Esq.; Edward Henry Mos-

crop, Esq.; Rev. Cyril W. Page, M.A.; Edmund Pepys, Esq.; The Lord Josceline W. Percy; Arthur Giles Puller, Esq., M.A., F.S.A.; Robert Ballard Woodd, Esq., F.S.A., F.R.B.S.

General Monthly Meeting, Monday, May 3rd, 1869.

Sir HENRY HOLLAND, Bart., M.D., D.C.L., F.R.S., *President, in the Chair.*

THE following Vice-Presidents were nominated for the ensuing year:—The Duke of Northumberland; William Spottiswoode, Esq., F.R.S., the Treasurer; J. P. Gassiot, Esq.; and George Busk, Esq.

Lieut.-Colonel Archibald Campbell Campbell; Sir William Dickason Clay, Bart.; William Wilbraham Ford, Esq.; John Benjamin Marsden, Esq.; and Herbert Schloss, Esq., were elected Members of the Royal Institution.

John Tyndall, Esq., LL.D., F.R.S., was re-elected as Professor of Natural Philosophy.

The Managers announced that, in conformity with the deed of endowment, they had appointed Michael Foster, M.D., F.L.S., Fullerian Professor of Physiology.

FRENCH ACADEMY OF SCIENCES.

Monday, April 26th, 1869.

A COMMUNICATION was read from the Rev. FATHER SECCHI, S.J., "*On the Spectroscopic Phenomena of the Sun's Spots*" recently observed by him; he finds that the spectra of these spots present great analogy with those of the stars known as Arcturus and Aldébaran. He also mentions that the different spots he had the opportunity to examine on the sun's disc exhibit differences identical to those which characterise the spectroscopical appearances of the stars.

During the proceedings of this meeting, at which no papers or communications on chemistry were sent in, several papers were read, and a long discussion ensued, on the aurora-borealis alluded to in our last report of the meetings of this scientific body; it appears that the phenomenon has been observed even in the southern parts of France, while perturbations of magnetic instruments have been reported from Leghorn as well as from Greenwich.

A discussion, wherein M. Sainte-Claire Déville took a prominent part, on the changes produced in the weather, barometric pressure, and temperature subsequent to the observation of the aurora-borealis, led to no definite result as far as the fixing of causes and effects in this matter is concerned.

M. L. HUGO, from Versailles, addressed a note "*On the Construction of a Synoptic Pyrheliosoope*," by means of which instrument it would be possible to see all the solar protuberances at the same time; the instrument is intended to be a spectroscope to which, by means of suitable clockwork, an angular motion may be imparted. The note and description were handed over to a committee to report thereon.

Two papers relating to electricity were read, but as both belong rather to the domain of higher mathematical physics, they are unfit and too abstruse for abstraction in our pages.

Monday, May 3rd, 1869.

A CONSIDERABLE portion of the time occupied by the meeting was devoted, as is too often the case with the *savants* who are seated there in the *fauteuils d'honneur*, to personalities.

General MORIN presented a report from the committee appointed to enquire into the alleged insalubrity attending the use of cast-iron stoves. The committee, of which the General was a member, has instituted a series of experiments on this subject at the Conservatoire des Arts et Métiers; the results arrived at are (1) all heating apparatus made of metal, and all stoves made of cast-iron, give off, while in use, a large quantity of carbonic oxide; (2) the quantity of that gas given off from stoves made of plate-iron, more or less thick boiler plate, is often insignificantly small; (3) the carbonic acid contained in the air is readily converted into carbonic oxide, by coming into contact with thoroughly red-hot cast-iron of the stoves made of that material; (4) the oxide of carbon thus generated may, especially in confined localities, become very injurious to health.

The committee recommend to line the cast-iron stoves inside with fire-bricks, and to envelope them outside with a casing of sheet-iron, so arranged as to leave space for free circulation of air in communication with a well-drawing chimney.

On behalf of Messrs. Mille and Durand-Claye, Ingénieurs des Ponts et Chausseés, M. Dumas reports on the work undertaken by these gentlemen, viz., the useful application of the sewage water from Paris, taken at the bridge near Asnières. Every cubic metre of this water contains 1 kilo. of solid matter, and 37 grammes to the kilo. are nitrogenous matter. The engineers above named treat this water with sulphate of alumina, whereby all the phosphoric acid, two-thirds of the nitrogenous matter, and rather more than one-half of the potassa salts present in the water are completely precipitated, and perfectly clear, inodorous water is left, which may either serve for irrigation of arable soil or meadows, or may be run off into rivers, without injury to the purity of the water of the same.

According to M. Morren, and contrary to the opinion given by M. Sarrasin, hydrogen and nitrogen gases become phosphorescent under the influence of an electric spark or galvanic current, provided the gases be perfectly pure, and under very reduced pressure. This statement gave rise to some discussion, since many of the *savants* present doubted the suitability of the means adopted by M. Morren to insure the purity of the gases at so low a pressure.

M. BERTHELOT read "*A Memoir on the Chemical Equilibrium between Carbon, Hydrogen, and Oxygen*," which we shall, probably, notice more fully at a future day.

Several papers were read about subjects relating to the geology of France, the meteorology and climate of the Isthmus of Suez, which, with some botanical papers, brought this meeting, as far as the public is concerned, to a close, at half-past five o'clock, p.m.

Monday, May 10th, 1869.

SOME very interesting papers were read, but, inasmuch as some of these do not belong to chemistry, or sciences intimately connected therewith, we confine our report to what chiefly interests our readers, and, in the first place, we notice some communications by the Rev. Father Secchi, S.J., "*On the Spectrum of the Sun's Spots.*" The learned astronomer, having found that the spectrum of red-coloured stars contains lines indicating the existence of carburetted hydrogen, has searched the spectrum of the sun's spots and faculæ, in order to detect therein, if possible, similar lines; and he has been successful in finding the same. We regret that we can only briefly notice this very important communication, since, without diagrams and woodcuts, it is not possible to enter fully into this subject.

M. KERIKUFF has addressed a brief note to the Academy on the subject of the scintillation of the stars. He states that, so far back as the year 1861, he had given an explanation of that phenomenon, identical with that lately set forth by M. Respighi. The note is handed over to a committee, for enquiry and report thereupon.

On behalf of M. Le Roux, M. EDMOND BECQUEREL read a communication "*On the Phenomena of Electric Light and Phosphorescence in the midst of (au sein de) Rarefied Gases.*" According to the author's statement, it is not at all necessary that an electric current should be made to pass through a gas: electricity by induction is sufficient to exhibit the phenomena. When a toothed wheel which is electrified is rapidly set in motion in close proximity to a tube containing any well-suited rarefied gas, the tube becomes illuminated and the gas phosphorescent.

M. des Cloizeaux read a paper on the crystalline form, the optical properties, and chemical composition of gadolinite, a rather rare mineral, some specimens of which exhibit double refraction, while others again do not. The mineral has been found hitherto only in Norway, near Hitteroe, and in Sweden, near Ytterby. The name of the mineral is derived from M. Gadolin, a Russian chemist, who first discovered this substance, and proved it to contain yttria and glucina, as well as the oxides of cerium, of lanthanium, and silica. M. des Cloizeaux states that the mono-refracting crystals ought to be referred to the epidote. The percentage composition of the gadolinite from Ytterby is, according to Dr. Berlin's analysis, quoted by the author—Silica, 25·62; oxide of yttrium, 50·00; oxide of cerium, 7·90; protoxide of iron, 14·44; lime, 30·00; magnesia, 0·54; alumina, 0·48; potassa, 0·19; soda, 0·18. Total, 100·65.

Our readers, on referring to our report of the meeting held on the 3rd of May, will find that M. Berthelot read a memoir on the chemical equilibrium between carbon, hydrogen, and oxygen. At this meeting the said gentleman read the concluding portion of his work. The chief fact observed is, that the decomposition of carbonic acid by the electric spark does not come to any fixed end—in other words, does not proceed beyond a certain limit—because the oxide of carbon and oxygen resulting from the decomposition of the carbonic acid have a tendency to become combined again and re-constitute carbonic acid.

M. Sainte-Claire Deville made a statement about his meteorological experiments and observations, from which he concludes that the changes of temperature are subject to periodical variations, returning regularly after 90, 30, and 10 days, due to and caused by the passage of our earth through different portions of the space of the universe. The same gentleman and M. Silbermann had a long discussion on the subject of the cause of the aurora borealis, which led, however, to no result of any importance to the general scientific public.

On behalf of M. Margueritte, M. Sainte-Claire Deville read a note setting forth the objections they have to make against the theory of M. Dubrunfaut concerning the supersaturation of sugar solutions in alcohol. The author says that Dubrunfaut has not proved by any experiment that when crystallisable sugar is dissolved in water, and alcohol added, any change should take place in the sugar itself. It is, therefore, evident that nothing else happens than the return to the solid state of a substance previously dissolved, and the crystallisation of which was impeded either by the presence of water, or some other unknown cause.

CHEMICAL SOCIETY.

May 6th, 1869.

Dr. A. W. Williamson, F.R.S., *President, in the Chair.*

The minutes of the previous meeting were read and confirmed.

The President then read a petition, to be presented to both houses of Parliament, of which the following is a draft:—

"*The Humble Petition of the President and Council of the Chemical Society,*

"Sheweth,—That the Chemical Society was incorporated by Royal Charter for the general advancement of Chemical Science as intimately connected with the prosperity of the manufactures of the United Kingdom. That in the opinion of your petitioners, the future intellectual position of Great Britain, and her success as a manufacturing nation, are in a great measure dependent on the scientific education of her people. That the Society of Arts, in their report on technical education, assert that the only effectual systematic training for technical pursuits consists of two steps—first, *a thorough study* of several branches of science, including chemistry; secondly, professional pupillage. That at the present time the study of natural science is altogether neglected in a large number of our secondary schools, while in the remainder it occupies only a subordinate position, both in respect of the time allotted to it and of the credit to be gained by proficiency in it. That the neglect of the study of natural science is in great part due to the influence exercised by the endowed schools, which, by their number, their antiquity, and the large funds at their disposal, determine the course of studies in other schools, their own course of education representing the requirements of a past rather than of the present age. That the necessity for inquiry into the teaching in endowed grammar schools has already been recognised by the appointment by Her Majesty of three commissions to report on this class of schools in England and Scotland. That the Schools' Inquiry Commission have, in their report, pointed out various practicable means for the promotion and extension of the study of physical science in schools. Your petitioners, therefore, humbly pray your honourable house to enact such laws as may procure for Chemistry, and other branches of natural science, as important a position among endowed school studies as that now occupied by Latin and Greek.—And your petitioners will, &c."

The following certificates were read:—

For the first time—Wm. G. Valentin, assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gillham Hewlett, Surgeon, Bombay Army, Health Officer, City of Bombay, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B. A. Oxford, Sympsham Rectory, Weston-super-Mare.

For the third time—E. Meusel, University College; A. W. Reinold, Merton College, Oxford; J. M. Muir, Shortland, Thames Gold Field, New Zealand.

The last-named gentlemen were then balloted for and duly elected.

Mr. J. Lowthian Bell then delivered a lecture "*On the Chemistry of the Blast Furnace,*" of which the following is a condensed abstract:—

There are few chemical processes requiring for their proper operation greater nicety, or where perfect success is contained within narrower limits than the smelting of iron.

The ends sought to be accomplished in the blast furnace are the deoxidation of the peroxide of iron, which is the usual form of combination in which the metal is delivered to the smelter, its carburisation, and fusion; and accompanying this is the expulsion of carbonic acid from the limestone, and the union of the lime it contains with the earthy matters associated with the ore and fuel to form a fusible slag.

The circumstance of the different stages of the operation being effected at different temperatures has led some chemists to divide the interior of the furnace into a certain number of spaces or regions, and designate them according to the character of the action which was supposed to be carried on therein.

Scheerer, among others, assigns a distinct zone to the various steps of the process, namely:—

The Warming Zone.—That is the uppermost part of the furnace, twelve feet downwards from the mouth, in which the ascending current of gases imparts a portion of its heat to the materials just entering the furnace.

The Reducing Zone.—That is the next adjoining seventeen feet of the furnace, where the oxide of iron begins to part with its oxygen, and in which, also, the carbonic acid of the limestone is expelled.

The Carburising Zone adjoined to the former, and comprising about nine feet of the height of the furnace, where it is supposed that carbon unites with the iron.

The Zone of Fusion —Supposed to be the next six feet of the furnace, in which the iron is melted, along with the earthy constituents of the materials, by means of the intense

heat given off immediately below in the fifth, or *zone of combustion*.

It is into the last zone that the blast is admitted, the oxygen of which is converted into carbonic acid, which gas, coming in contact with incandescent coke, or charcoal, generates carbonic oxide to serve as reducing agent in the upper portion of the furnace.

Scheerer states the degree of temperature of those different zones to be 400° C., 1000—1200°, 1600—1700°, 1800°, and 2000—2650° C. respectively.

Tunner, of Leoben, has, by means of different alloys and various metals, attempted to determine the temperatures of blast furnaces, and he further endeavoured to ascertain by actual exposure of ore at different depths of the furnace the exact point at which reduction began and the rapidity with which it was effected. This he accomplished by placing in a box with the top and bottom provided with apertures, so that a portion of the gaseous contents of the furnace passing through its interior might heat and deoxidise any ore placed therein. This apparatus was introduced into the furnace, and permitted to descend to different depths along with the usual materials, and was then drawn up by means of a windlass.

Tunner marks a depth of about 20 feet from the throat as the commencement of the process of reduction, which was reached twenty minutes after the ore was introduced into the furnace, and at which the temperature was as high as 700° C.

Ebelmen, by means of apparatus similar to that employed by Tunner, ascertained that reduction commenced at a depth of 8·2 from the top, and after the ore had been two hours in the furnace, and that it was completed at a depth of 18·9 from the throat after an exposure of 6h. 25m.

These investigations have induced them to assume lines of demarcation in blast furnaces (which are represented in sketches adjoined to the paper).

It is, however, doubtful whether any such lines can be laid down in blast furnaces, because to do this would require that each fragment of ironstone is descending with the same speed as all those introduced at the same time, and that every piece is susceptible of being deoxidised as rapidly as the remainder. Neither of these conditions takes place.

Besides, the friction of the materials against the sides of the furnace, particularly when they reach the slopes or boshes, retards considerably the descent of those portions exposed to its influence. The uniform motion of the mass downward is further liable to considerable disturbance by the smaller pieces of ironstone outrunning the larger by slipping through openings in the contents of the furnace, a mode of progress which cannot happen with those of larger dimensions.

Again, the size of the pieces of ironstone exercises a marked influence on the rapidity of the chemical action which the oxide of iron has to undergo during its passage through the upper portion of the furnace. A piece of ore containing a cubic inch of matter, will be perfectly reduced almost before any action has commenced on a second piece of ore, containing a cubic foot, supposing both pieces travelling side by side. In like manner the expulsion of the carbonic acid from the limestone is influenced.

The same delayed action will happen if a considerable quantity of small material is permitted to accumulate in a given portion of the interior of the furnace; indeed, there is perhaps no circumstance which more frequently deranges the operation than this.

The information which is sought to be obtained respecting the temperature of the different sections of a furnace is attended necessarily with considerable difficulty.

Tunner and Ebelmen's mode of judging of the rate of the reduction might be accepted as an indication of what it is under the most favourable circumstances as to size, inasmuch as in his apparatus of limited capacity he only introduced pieces of ore having very small dimensions. The very circumstance, however, of the mineral being incased within a box, introduces an element of difference between the samples under experiment and those in the furnace.

The lecturer's observations would indicate that the oxide of iron, when exposed to the unimpeded action of the gases of a blast furnace, is reduced at a temperature considerably below that assigned by any of the authorities already referred to, and, further, that the rapidity of the process is materially interfered with by any protection like that involved in the use of such a vessel. In order to form some judgment of the temperature and rapidity with which the oxide in the calcined oolitic ironstone of Cleveland was reduced by means of carbonic oxide, a glass tube was filled with pieces about the size of hemp-seed, and heated short of redness. In this state a stream of carbonic oxide was passed over it, and the resulting gas collected and examined. It contained 96 per cent of carbonic acid. A portion of the iron ore so treated was examined, and found to have in the space of 15 minutes lost 39 per cent of its oxygen.

After this a number of specimens of calcined ironstone were exposed at various times to the escaping gases of the furnaces for periods from 1 to 96 hours. Some specimens were placed on an open tray, others in a perforated box, about 6 or 8 feet from the furnaces in the tube for conducting the gas to the boilers, &c. The furnaces employed varied in height from 48 to 80 feet. The temperature of the gases rarely exceeded the lowest of the figures stated by Scheerer, Tunner, and Ebelmen, and frequently considerably below that. Conceding that the gases from the largest furnaces are the coolest, and from the smallest the hottest, the deoxidation is the most vigorous from the small furnaces, and generally speaking, decreases with each addition to its capacity.

The deoxidation of the iron ore to a certain degree increased with the length of time for which the ore was exposed, and amounted, in one instance, even to 100 per cent; the reduction of the ore placed in a perforated box, and not on an open tray, was sensibly interfered with. (Mr. Bell has adjoined a full list of his experiments to his paper.)

In order to investigate whether the proportion of carbonic oxide contained in the gas might possibly affect the rate of the action on the ore, artificial mixtures containing 13CO, $16CO_2$, 71N, and 32CO, $6CO_2$, 21N, respectively, were separately passed over calcined Cleveland ironstone. Both results proved that almost complete conversion of carbonic oxide in carbonic acid takes place, and that the want of power of deoxidation is not due to a lesser proportion of carbonic oxide.

These and other trials prove that, although mass may retard the action and even delay it until sufficient heat has been imparted, these gases, at a temperature considerably below that stated by the foreign chemists, are sufficient to deoxidise ores of iron.

During the passage of the reduced iron through the furnace, and under the influence of the high temperature to which it is exposed, on its way to the hearth, the metal is apt to carry down some of those substances with which it was originally associated in its ore, or which it meets with in the flux or fuel. To such an extent may this occur that Fresenius quotes a case in which he detects not less than twenty substances other than iron in a specimen he analysed. In some cases as much as 22 per cent of manganese has been found, and above 5 per cent of silicon; but of all those elements mentioned by Fresenius, it is only carbon which may be looked upon as a necessary ingredient of all pig-iron. The circumstances which determine the union of this indispensable element with the metal is one of the highest interest. The portion of the furnace in which the combination takes place, the temperature necessary for effecting it, and the exact source of immediate supply, have engaged the attention of all chemists who have studied the subject. Scheerer assigned it something like the position before described.

Tunner, by means of his perforated box, determined that carburisation did not take place until a depth of 29·8 feet from the top of the furnace was reached, at a temperature of about 1150° C. Ebelmen's idea of the zones of reduction and carburisation is somewhat higher up.

It was next enquired whether it is not highly probable that the box confining the iron ore has not interfered with the action of carburising in the same way as happened, in all probability, with that of deoxidising.

In order to ascertain the extent of change in content of iron, the samples were, after exposure, dissolved in hydrochloric acid, affording, of course, an insoluble residuum.

When a sample of calcined ironstone was exposed for the space of two hours in the waste gas, the residuum was of a greyish colour. The same may be said when the exposure was carried on for three hours with gases produced in the larger furnaces. The smaller furnaces evolve hotter gases —zinc in them frequently melting, and occasionally antimony. The insoluble residuum under consideration, from a specimen after three hours' contact with the hot gases, was blackish, and this went on increasing as the exposure was prolonged, until it became perfectly black. On the other hand, larger furnaces having above 4½ times the capacity (26,500 cubic feet instead of 6000) never gave off its gases, during a period of observation extending over 96 hours, hot enough to melt zinc; for during 72 hours of this time lead melted, and for the latter 24 hours bismuth only was fused. Ironstone exposed during 96 hours only afforded a greyish insoluble residuum on being treated with hydrochloric acid.

From these observations it is concluded that an exposure of three hours to a temperature a little above the melting point of lead and below that of zinc sufficed to give the black colour, whereas at about the temperature at which lead fuses, no period up to 96 hours sufficed to produce it.

On examination the blackening was found to consist of carbon. This carbon, moreover, exists in such a minute state of division as to induce the belief that it is really combined with the iron; and it seems highly probable that the carburisation takes place at that comparatively low temperature. Neither does it appear that anything approaching to complete deoxidation is required, for in one case only 6·10 per cent of the oxygen of the ore was driven off, whilst the residuum was blackish, and with anything like 50 per cent of loss of oxygen, the colour is intensely black. On the other hand, oxygen may be removed to the extent, at all events, of 28 per cent, and no strongly-marked signs of carbon appear in the residuum if the heat during exposure has not reached the necessary point of elevation. In the case of the raw ironstone, the colour was much blacker than when the calcined ore was used.

One duty of limestone in blast furnaces, but not the only one, is to act as a flux, by melting and separating the solid impurities of the ore. It is usually considered that the use of an excess of lime promotes the separation of sulphur, and, it may be, phosphorus.

Mention has already been made of the difficulty of drawing any general conclusions respecting the progress of the operation of smelting from an examination of analyses of the solid contents of a blast furnace. It may be also questioned whether the current of gaseous matter would have anything like a uniform composition over any horizontal section corresponding to the point where the samples were taken.

Considering the properties of carbonate of lime when exposed to heat in an atmosphere of carbonic acid, the problem of drawing, from the presence of this gas, any general inference of the chemical change going on in a furnace, becomes very intricate, if, indeed, not impossible.

This salt of lime parts with half its carbonic acid at a moderate red heat, a much higher temperature being required before the whole is expelled; the last half, more or less, will not be set free until it meets with hot carbon, when it is instantly resolved into carbonic oxide.

Caustic lime is frequently employed in the operation, but *this does not simplify the enquiry*, but rather the reverse. Up to a temperature of redness, I ascertained lime absorbed carbonic acid in proportion to the temperature to which it was exposed—*i.e.*, the higher the heat the more rapid was the union; this increase went on until 19 per cent of the weight of the lime was taken up, after which a stream of the gas, continued for nine hours, produced no further change. On the other hand, carbonate of lime and caustic lime were subjected to a current of carbonic acid in a porcelain tube, and heated until the latter began to soften. In this case there was no absorption of carbonic acid, and, on the contrary, all the acid was drawn off from the carbonate.

So far as moderate temperatures are concerned, it was ascertained that caustic lime rapidly absorbs carbonic acid from the escaping gases.

(To show the want of uniformity in composition of the gases from different depths of the furnaces, as determined by analyses, Mr. Bell exhibited diagrams, drawn to scale, in which the amounts of carbonic acid and carbonic oxide are represented by darker and lighter shades.)

If the gases of a blast furnace have to furnish us with any data from which we may draw just conclusions of the nature of the chemical action going on in its interior, it appears to me little reliance can be placed on any analyses, excepting those of the gases as they escape.

It is not a difficult matter to calculate what the decomposition of furnace gases ought to be, supposing a certain quantity of coke and limestone to be consumed to the ton of iron, and the sole source of carbonic acid to be the ore by its deoxidation.

Assume the coke used to be 23·20 cwts., and the limestone 11·60 cwts. per ton of pig-iron, containing 19 cwts. of pure iron.

The coke may be taken as consisting of—

	cwts.
Pure carbon	21·80
Ash	1·40
	23·20

And the limestone will consist of—

		cwts.
Lime		6·50
Carbon 1·39 Oxygen 3·71	to form carbonic acid	5·10
		11·60

The ironstone will consist of—

	cwts.
Iron	19·00
Oxygen	8·14
Earths	22·86
	50·00

The total carbon, then, to be dealt with is, in—

	cwts.
Coke	21·80
Limestone	1·39
	23·19
From which must be deducted the carbon to combine with the iron—	0·74
Leaving to go off as carbonic acid and carbonic oxide—	22·93

The total quantity of oxygen we have in the minerals, applicable to oxidising carbon, is—

	cwts.
In the ore	8·14
In the limestone	3·71
	11·85
To which may be added from the decomposition of water contained in the blast—	00·85
	12·70

To convert 22·93 cwts. to the state of carbonic oxide, there will be required of—

	cwts.
Oxygen	30·57
But, as applicable to these, we have in the limestone 3·71, and in the water in the blast 0·85—	4·56
To be derived from the atmosphere	26·01
26·01 atmospheric oxygen is equal to nitrogen—	87·07
8·14 oxygen in the ore will give of carbonic acid, generated by its action on carbonic oxide—	22·38
22·38 carbonic acid contains 6·10 of carbon, having 16·83 (22·93–6·10) to give of carbonic oxide—	39·27
	148·72

Supposing, then, the carbonic acid from the limestone to be decomposed, and that generated by the reduction of the ore to escape as such, the proportions in which nitrogen, carbonic acid, and carbonic oxide should be found in the escaping gases would be—

Nitrogen	58·54
Carbonic acid	15·05
Carbonic oxide	26·41
	100·00

Analyses of the gases from a blast furnace, melting forge iron with precisely the quantity of materials named in the above calculations, show figures in a close approximation to the theoretical calculation.

We will now devote a few minutes to an examination of the blast, by means of which we obtain heat from the fuel to fuse the iron slag, and generate carbonic oxide to effect the reduction and carburisation of the metal which is the object of the process.

The effect of cold on our atmosphere being to deprive it of a considerable portion of its moisture, and to contract its bulk, a cubic foot of air in winter contains, of course, less watery vapour and more oxygen than is embraced within the same space in summer.

The chief recommendation of the hot blast is the economy of fuel obtained by means of its use; and it is this attribute which possesses interest to ourselves as chemists, furnishing as it does a field of enquiry into the nature of combustion, and the appropriation of heat in blast furnaces.

If it can be shown that the progress of smelting science has been such as to reduce the consumption of coke in a furnace blown with cold air until it is within 10 or 11 cwts. per ton of iron of that used in a furnace supplied with air heated to 339° C., this is the saving we are called upon to explain.

Granting, then, for the present moment, that such saving, under the circumstances named, may be realised, it is to be remembered that the blast has the 339° of heat communicated to it by means of 5 cwts. of coal, of which, I have ascertained, more than one-half is wasted in the hot-air apparatus; so that, practically, you have the heat of 2 cwts., or barely that, of fuel burnt outside the blast furnace, effecting a saving, in that burnt in its interior, of 10 to 11 cwts.

In practice, we are pretty near the truth in accepting as a fact, that an estimate of heat developed by the blast on the coke is obtained by considering its oxygen converted into carbonic oxide; for, although at the instant of its admission carbonic acid is generated, this substance is almost as rapidly converted into carbonic oxide by the action of the candescent coke. But, in the hot-air stoves, the 2 cwts. of carbon are converted permanently into their highest state of oxidation; and, taking the units of heat as 2221° C. for burning carbon to carbonic oxide, and as 7900° C. for burning carbon to carbonic acid, the 2 cwts. burnt in the stove will represent 7·11 cwts. of carbon burnt in the furnace, or, say, something like 7¼ cwts.

In round numbers, therefore, we may consider 7¼ cwts. of our saving of 10 or 11 cwts. to be accounted for, leaving still 2½ or 3½ cwts. for further investigation.

Now, let us assume that the coke required is 40 cwts. for the ton of cold blast iron, and in the furnace, blast heated to 339° C. is suddenly introduced, which is equal in caloric power to 7¼ cwts. of coke; so that, so far as a mere question of heat is concerned, something like 47½ cwts. of coke is being applied to the production of a ton of metal for which 40 cwts. will suffice.

A common yield of calcined clay ironstone is 40 per cent; so that 50 cwts. are required for a ton, to which has to be added, say 12 cwts. of limestone.

The burden, then, for 1 ton of cold blast iron would be—Coke 40 cwts., calcined ironstone 50 cwts., limestone 12 cwts.; but, by the addition of the equivalent of 7¼ cwts. of coke, these proportions will require a corresponding modification, and a ton of iron will be represented by heat in blast 7¼ cwts., and in coke 32¼ cwts., together 40 cwts.; calcined ironstone and limestone, as before, 62 cwts. together.

But what is the effect on the furnace itself by such a change in the proportion of its contents? To answer this, let us imagine a furnace with a capacity of 6,000 cubic feet.

The weights of the materials used at the Clarence Works have been carefully ascertained; and it was further determined that the weight of material in a furnace, before being lighted, was such as to cause a compression like 25 per cent; so that a furnace of 6,000 cubic feet would contain 7,500 cubic feet of materials, as measured in the charging barrows.

It therefore appears such a furnace, working on cold blast, would contain—

	tons.
Coke	56
Calcined ironstone and limestone	87
	143

But, introduce the air, heated so as to reduce the coke to about 30 cwts. to the ton of iron, and the furnace would contain.

	tons.
Coke	50
Calcined ore and limestone	103
	153

It would be almost impossible to ascertain to what extent these figures become modified by the action of the heat when the furnace is in blast, or what the effect of the altered proportions would be on the temperature of the ascending gases. To obtain the exact figures for this, we ought to have the specific heat of all the various materials in the furnace.

That the withdrawal of so many cubic feet of coke, and its substitution of substances nearly three times its weight, and with a mean specific heat rather higher than that of the coke itself, must permit a more perfect absorption of heat from the ascending current of gas, is obvious.

Looking at the complicated nature of the problem, it appears as if there is no alternative left but to ascertain the actual amount of heat carried off in the escaping gases, after they have performed their work in the furnace: and this, during a whole day, was done at the Cyfarthfa Works, in a hot and cold blast furnace.

The temperature of the gases was ascertained by a pyrometer, consisting simply of a copper tube, about 3 feet long and 1 inch diameter, closed at the lower end, and screwed into a Bourdon's pressure gauge.

The gases were assumed to contain according to weight—

$$9CO_2,\ 32CO,\ 59N = 100.$$

cwts.	cwts.	cwts.
The C in CO_2=2·45;	C in CO = 13·71.	Total C...16·16
The O in CO_2=6·55;	O in CO = 18·29.	Total O...24·84
Total CO_2..9·00.	Total CO...32·00.	Total C+O 41·00

	cwts.	cwts.
Coke used per ton of iron was—		34·80
Deduct ash (5 per cent).....	1·74	
Deduct HO (5 per cent).....	1·74	
Deduct for combination with iron	0·74	
		4·22
		30·58
Carbon in limestone.....		2·12
Total carbon going off in gases.....		32·70

With the composition of the gases given above, the carbon will be volatilised in the following state:—

	cwts.
CO_2.....	4·96
CO.....	27·74
	32·70

		cwts.
C 4·96, for conversion to CO_2, requires O....		13·23
C 27·74, for conversion to CO, requires O.....		36·99
32·70	Total O.....	50·22

But in the materials themselves there is—

O in the CO_2 of the limestone used (17·66 cwts. per ton of iron).....	5·65
O in 48·43 ores (part of Fe being as FeO)	7·35
	13·00
Having to be supplied by blast of O.....	37·22

The total weight of the gases would then be—

	cwts.
Carbon.....	32·70
Oxygen.....	50·22
Nitrogen, accompanying 37·22 O of blast	124·60
Water in coke 1·74; water in ore 2·19....	3·93
	211·45

We have a total weight of gases—

	cwts.
C 4·96 + O 13·23 = CO_2..... ..	18·19
C 27·74 + O 36·99 = CO.....	64·73
N	124·60
HO.....	3·93
	211·45

The mean temperature of these gases as they left the furnace was ascertained to be 445° C.

By multiplying these weights by their various specific heat and temperature we have—

$$\left.\begin{array}{l} CO_2\ 18{\cdot}19 \times 0{\cdot}212 \times 445^\circ \\ CO\ \ 64{\cdot}73 \times 0{\cdot}288 \times 445^\circ \\ N\ \ 124{\cdot}60 \times 0{\cdot}275 \times 445^\circ \\ HO\ \ 3{\cdot}93 \times 1{\cdot}000 \times 445^\circ \end{array}\right\} \ldots\ldots\ldots 269{\cdot}67$$

And this divided by 2221 units of heat burning C to CO, gives 12·16 cwts. of carbon, or, say, 12·76 of dry coke, as going off with the escaping gases from the cold blast furnace.

In the case of the hot blast furnace, with air heated to 320° C., the calculation stands thus:—

	cwts.	cwts.
Coke used per ton of iron was.....		26·74
Deduct ash in coke (5 per cent)....	1·33	
" HO " (")....	1·33	
" C to combine with iron.....	0·74	
		3·40
		23·34

Lime added in caustic state; hence there is no carbon to include from this source. Upon the same basis as the previous calculation, the carbon will be given in the gases as—

	cwts.
CO_2.....	3·53
CO.....	19·81
	23·34

cwts.		cwts.
C 3·53 requires for conversion to CO_2 of O		9·41
C 19·81 " " " CO of O		26·41
23·34		35·82
Less O in the ores, part existing as FeO....		8·12
Leaving O to be supplied by blast.....		27·70

Total weight of gases will be—

	cwts.
Carbon.....	23·34
Oxygen.....	35·82
Nitrogen accompanying 27·70 O....	92·73
Water in coke, 1·33, in ore, 1·73....	3·06
	154·95

The mean temperature of the gases is ascertained to be 477° C., and their estimated constitution would be as follows:

	cwts.
C 3·53 + O 9·41 = CO_2.....	12·94
C 19·81 + O 26·41 = CO.....	46·22
N.....	92·73
HO.....	3·06
	154·95

By multiplying these weights by temperature and specific heat we have—

$$\left.\begin{array}{l} CO_2\ \ 12{\cdot}94 \times 0{\cdot}212 \\ CO\ \ \ 46{\cdot}22 \times 0{\cdot}288 \\ N\ \ \ 92{\cdot}73 \times 0{\cdot}275 \\ HO\ \ \ 3{\cdot}06 \times 1{\cdot}000 \end{array}\right\} \times 477^\circ = 21274$$

This divided by 2221 = 9·57 carbon, or dry coke, 10·04.

	cwts.
Now, as the weight of coke per ton of iron escaping represented in heat from the cold blast furnace has been shown to be	12·76
Whereas with hot blast it is only.....	10·04
It follows there is escaping from the former above that going off from the latter heat equal to coke.....	2·72

We have the total saving of coke as follows:—

	cwts.
1st. By use of blast heated as formerly stated	7·50
2nd. By diminution of loss of heat in the escaping gases.....	2·72
	10·22

which accords with the saving stated to be effected by the use of 5 cwts. of coal, of which only about 2 cwts. were really available.

Mr. Bell concluded his paper by giving in detail several other comparisons of two different furnaces carried on with cold and hot blast respectively.

[English Edition, Vol. XIX., No. 494, pages 245, 246.]

The PRESIDENT, in inviting discussion, said—There is scarcely any branch of manufacture which requires so many various qualities of a rare and high kind as this particular one in which Mr. Bell is pre-eminent, and, certainly, among iron-masters there is none equal to himself in the combination of those various qualities. His scientific skill and industrial vigour have led to the construction of iron furnaces which are unsurpassed in the perfection of the operations which pertain to them. The subject is one so complicated that Mr. Bell's views will be considered exceedingly valuable in relation to it, and, certainly, all will feel interested in having so full and so masterly an exposition from himself in this matter.

Mr. SIEMENS—With regard to the saving effected by hot blast, a great deal of controversy has taken place, and I am very glad to see that Mr. Bell has really tackled the question by reducing it to figures. At first sight it appears strange that the combustion of 2 cwts. of carbon added to the blast should save 10 cwts. of coal in the blast furnace; but a little consideration, I think, would bring us already to this conclusion. If the result of combustion was carbonic acid only, then every 6 lbs. of carbon added in the shape of heat to the blast would necessarily save 14 lbs. in the furnace, that being the proportion of heat developed in burning carbon into carbonic oxide and into carbonic acid; but we find the result of combustion is not carbonic oxide but a mixture of carbonic oxide and carbonic acid. It may be assumed to be, in a furnace worked with hot blast, 1-5th carbonic acid and 4-5ths carbonic oxide; and, if we take these proportions, we shall find that the effect of 1 lb. of combustion outside the furnace would probably produce a saving of 4 lbs. inside the furnace. But why is the saving greater? If we suppose that a mixture of air, reduced ore, and carbon, comes down the furnace, and it is met by the blast, the first action is complete combustion into carbonic acid; but almost simultaneously with that action the reducing action, or the absorbing action of the carbonic acid upon carbon, takes place also. The carbonic acid is reduced to carbonic oxide, and this reduction is accompanied by a great refrigerating effect. If cold blast is used, there must be a larger proportion of carbon present with the ore, and there must be a larger surface of carbon at once exposed to the carbonic acid formed in order to effect its reduction. It has been determined practically that a cold blast furnace not only works hotter at the top, but that the proportion of carbonic acid is greater in the case of a hot than a cold blast furnace; it would, therefore, follow that the hot blast has not only produced a higher temperature at the bottom, but reduced a mixture of carbonic oxide and carbonic acid, giving larger margin of heat developed, or less refrigerating action introduced by the formation of carbonic oxide. Perhaps Mr. Bell will be kind enough to tell us whether, on raising the temperature of the blast, the proportion of carbonic acid gas at the top of the furnace is not increased.

Mr. BELL—If you had a hot and cold blast furnace working together, irrespective of the results, with the same quantity of fuel, and the same quantity of ore, then the comparison Mr. Siemens is making would be a perfectly true one. But it happens to be the case that, upon a comparison of the Clairvale furnace, blown with a hot and with a cold blast, you find the volume of carbonic acid in the cold is considerably greater than that in the hot.

Dr. PAUL—If we compare two furnaces, one worked with cold blast, and burning fuel at the rate of 2 tons for each ton of iron produced, and a hot blast furnace, worked so that the consumption of the fuel is at the rate of only 1 ton for each ton of iron produced, we must remember that, in fact, the largest proportion altogether of the materials passing through those furnaces in both cases is the air by which the combustion is supported. Therefore, taking it for granted that in both cases the discharged gases go away at the same temperature, we have in the one blast furnace twice the amount of gaseous material passing through the furnace, and twice the quantity of heat being carried off in that escaping gas. Therefore, it is evident that the quantity going away to waste in the cold blast furnace is twice as great as in the hot blast furnace, and if we had the waste twice as much in the one case as it is in the other, it is very evident that in the hot blast furnace there must be very considerable saving.

Captain NOBLE—With respect to the ratio between carbonic acid and carbonic oxide in the waste gases, Mr. Bell has found that, within a very short time, and while apparently the furnaces are working precisely the same, there is a very great difference in their ratio. I entirely agree with what Mr. Bell has said, and I believe very little in the analyses of tunnel-head gases. The analyses of gases taken from pipes are, I believe, entirely fallacious. It is almost impossible to believe that ratios in crooked lines, like what we see on the diagram, can really exist in a furnace, and it is very evident that when we take gas from a furnace by means of a small pipe, the nature of that gas will change very much in accordance with the last substance with which the gas has come into contact—whether it be coke, for example, or whether it be ironstone. I have had occasion myself recently to make an investigation with reference to the determination of the number of units of heat produced in a furnace, and what became of them. In so doing, I have endeavoured to trace the number of units of heat that go away with the tunnel-head gases, and which are re-produced again when the tunnel-head gases are burnt, and so on. And, finally, I have worked it out in the work that is done by the engines and other means. The great variations that Mr. Bell has found in his analyses of his gases from the pipes is entirely confirmed in another way, and that is, by the amount of water vaporised. In the space of three or four hours the amount of water vaporised varied most enormously, and, if I remember right, Mr. Bell found a variation in the ratio of the carbonic acid amounting to something like 20 per cent of the whole amount. The ratio also varies much in the different furnaces.

Mr. CROSSLEY—It is certainly surprising to find that iron absorbed carbon at so early a stage in the furnace. I have passed pure carbonic oxide over pure sesquioxide of iron, and I never noticed any deposition of carbon, and I am rather afraid that, in the case of Mr. Bell, the calcined stone has not been fully calcined in the interior of the stone, and perhaps the carbon which he has obtained in the deposit is the carbon which was left in the stone. Mr. Bell has also told us something which I consider very interesting in reference to the proportion of limestone that may be used in a furnace, and he stated that the smaller the quantity of limestone used the larger the percentage of sulphur which comes off in the pig-iron. We tried some years ago some experiments in which we used 3½ cwts. of limestone, 7 cwts., and, I believe, 14 cwts., and we have found that the silicon and the sulphur in the iron came off in larger quantities in the iron where the smallest quantity of limestone was used, and there was a smaller proportion of metallic bases in the pig-iron produced from the smallest quantity of limestone.

Mr. COCHRANE—I shall be glad to offer a few observations on the subject of hot blast, which has been rather a pet subject with me for a great many years. I believe it is an admitted fact, that the colder oxygen is, and, of course, the more dense it is, the more intense is the action of combustion due to that oxygen, and that there is no advantage in warming it. But not so, I believe, with nitrogen, and, of course, with the mixture of atmospheric air. I think that the question of heating that mass of nitrogen has been rather overlooked in the paper; and not only has an enormous amount to be heated in the furnace, but, I believe, a greater weight of nitrogen has to be heated for every ton of iron that is reduced. Mr. Bell has alluded to a dark appearance before the tuyere. It is notorious that this dark appearance extends, in many instances, to a long tube, right into the centre of the cold blast furnace; and that is really part and parcel of the heating apparatus which enables the blast to be delivered in the cold blast furnace at the requisite temperature for the quality of iron required. Hence it needs the element of time of combustion to be taken into account, or not the time of combustion rather, but that the

material—the coke—is, in being burnt, higher in a cold blast furnace, by reason of the time required for heating all the nitrogen, and so on, than is the case in a hot blast furnace, where you start with temperature of, we will say, 1000° F., and where there is no longer any necessity for heating that blast inside the furnace. The zone of fusion is spread lower down the tuyeres, and so, *pro tanto*, you gain in height of furnace.

Mr. Bell—I will not take up many minutes in replying to the questions which have been put before us. One point raised was as to the greater volume of gases escaping from a cold blast furnace than from a hot. Well, I have not given figures on that point, because, as I stated before, I have intruded too long upon the company already. But it was, of course, impossible to ascertain the quantity of heat escaping by the gases at a certain temperature, unless I had known the quantity of gases escaping, which was a necessary element in the calculation. With respect to the observations of Mr. Crossley, with regard to the possibility of the carbon in the ironstone being the cause of the deposition of the carbon in the iron, I would remind him that a certain temperature was required. If this was deposited from the carbonic acid already existing in the iron ore, how did it happen that it never found its way there, when it was exposed merely in a blast furnace having the escaping gases going out at a temperature something like melting lead? There was an invariable connection between the temperature of the escaping gases and the appearance of this carbon. With regard to my friend Mr. Cochrane, all I can say is this, that I am not prepared to dispute whether it is better to heat the oxygen or better to heat the nitrogen. But this appears to me quite certain, that, as you look upon the blast as a mere vehicle for conveying the heat, it is a matter of perfect indifference whether the heat is carried in by 8 lbs. of oxygen or 14 lbs. of nitrogen.

I have made diagrams, not from imagination, but based upon actual analyses of the gases, to show that, at a given point, the whole of the oxygen of the blast is absorbed, and whether the blast went in hot or cold appeared to make no difference. The carbonic acid was as readily reduced to the condition of carbonic oxide in the hot blast as in the cold. The figures before you illustrate quite truly the temperature of the gases as they were coming from two furnaces and at different periods of the day; and they merely show the irregularity of action of all blast furnaces, and how impossible it is, from a few observations, to draw any general expression as to their action.

Mr. W. Chandler Roberts then gave a verbal account of, and exhibited the apparatus for showing the expansion of palladium by hydrogenium. It consisted of a coil formed with a strip of palladium and a strip of platinum, each being 300 m.m. long, 3 m.m. wide, and 0·3 m.m. thick. This is put into a glass vessel filled with acidulated water; a plate or wire of platinum is placed near it, and the ribbon or wire connected with either pole of a battery by means of a commutator. The coil is first connected with the zinc pole of the battery, hydrogen is then thrown on the surface of the palladium, when the gas is absorbed and the spring opened. The direction of the current being reversed, oxygen is thrown on the surface of the metal, which consumes the previously occluded hydrogen and causes the index to move rapidly back to zero.

May 20th, 1869.

Dr. A. W. Williamson, F.R.S., *President, in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following certificates were read:—

For the first time—Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. Fletcher Barrett, Lecturer on Physical Science at the London International College.

For the second time—Wm. G. Valentin, Assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gilham Hewlett, Surgeon, Bombay Army, Health Officer City of Bombay, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A. Oxford, Sympsham Rectory, Weston-super-Mare.

The President announced that, in accordance with a letter he had received from M. Dumas, the Committee had made arrangements for the inaugural Faraday discourse to be given by M. Dumas on the 17th of June, and for the banquet to take place on the 18th.

The Secretary then read a short paper by Dr. Schorlemmer, "*On the Constitution of Hyposulphurous Acid.*" The author referred to the experiments of Dr. Dupré, and the views lately expressed by Dr. Odling, which seemed to be supported by Rose, who states that no hyposulphite is capable of existing which does not contain at least one atom of hydrogen, and proposes to reduce the molecular weight of hyposulphurous acid to one-half. The author thought that it could not be generally known that Rose's statement was incorrect. Pape * found all the hydrogen present in the form of water of crystallisation, which, with care, could be expelled without the salt being decomposed; but the last portion of the water is driven off at a temperature only a few degrees below that at which decomposition begins. By heating the sodium, potassium, and barium salts to 215° C., they can be obtained anhydrous, while at 5° higher they decompose. The lead-salt is anhydrous at 100°, but at a few degrees higher it blackens. In many reactions, the molecule of hyposulphurous acid split up in such a way that the atom of sulphur previously contained in the sulphur dioxide remained in the oxidised state, whilst the other atom separated as free sulphur, or a sulphide—

$$Na_2S_2O_3 + 2HCl = 2NaCl + H_2O + SO_2 + S.$$
$$Ag_2S_2O_3 + H_2O = Ag_2S + H_2SO_4.$$
$$Hg_2(NO_3)_2 + Na_2S_2O_3 + H_2O = 2HNO_3 + Hg_2S + Na_2SO_4.$$

The author, therefore, thought that the old formula, proposed by Dr. Odling fourteen years ago, must be retained for hyposulphurous acid, and that it must be considered as sulphuric acid, in which one atom of oxygen had been replaced by sulphur.

Dr. Odling referred to the discussion which followed the paper by Professor Stokes, "On a Certain Reaction of Quinine," when, in speaking of the non-fluorescence of the hyposulphite, he ventured to say that it might be that, after all, the compounds of hyposulphurous acid were not really oxygen salts, but that they were, instead, halogen salts; and, in favour of that view, he had quoted the observation of Rose, but he was not aware that this observation had been refuted. He (Dr. Odling) would like to call to mind the different views put forward with regard to the hyposulphites. Having regard to empiric formulæ only, such a salt as sulphate of soda is represented as Na_2SO_4. The pentasulphide of sodium has the formula Na_2S_5, so the S_5 might be taken to correspond with the S and the O_4. The next salt in the list would be the intermediate one, $Na_2S_2O_3$, the ordinary mode of expresssing hyposulphite of soda. In Sir Robert Kane's "Manual of Chemistry," a salt was described having the composition $Na_2S_3O_2$, and it was said that this salt crystallised with the same number of atoms of water of crystallisation as the hyposulphite, and was isomorphous with it. Then there only wanted the intermediate salt, Na_2S_4O, of which he (Dr. Odling) had never heard; but, admitting the existence of the salt described by Sir Robert Kane, and accepting the other formulæ, they would have a complete series, as follows:—

Na_2SO_4
$Na_2S_2O_3$
$Na_2S_3O_2$
Na_2S_4O
Na_2S_5

* *Poggendorff's Annalen*, cxxii., 408.

a series which seemed natural and likely to exist. If they oxidised sulphite of soda by any means, it became Na_2SO_4; and, if instead of oxidising it, they sulphurised it, it at once became $Na_2S_2O_3$: there was, therefore, an analogy in ultimate formulæ, and also an analogy in the particular mode of formation. Professor Kolbe had succeeded in making formic acid by reducing carbonic acid with sodium, thus: $H_2CO_3 + Na_2$; and there was produced in this way formiate of soda, $NaHCO_3 + NaHO$, which remained combined with the excess of carbonic acid. This reaction was, at first sight, very similar to the ordinary reaction by which a hyposulphite was obtained by the action of sulphurous acid. The hyposulphite could be obtained very readily by dissolving zinc or iron in sulphurous acid, but they would use sodium, as before, and they obtained a result which is capable of being expressed thus: $H_2SO_3 + Na_2 = NaHSO_2 + NaHO$, which remains combined with the excess of sulphurous acid employed. This fact had led Dr. Dupré to form the opinion that carbonic and sulphuric acids were the analogues of each other. He (Dr. Dupré) made several experiments by acting upon carbonates with carbon, and the result of these experiments led him to believe that he actually formed formic acid. But the experiments, as Dr. Dupré acknowledged, could not be considered as altogether conclusive. With regard to formic acid, all experimental evidence tended to show that they had the carbon united with hydrogen and with oxygen, and also with oxygen already combined with hydrogen. But if they were right in saying that sulphurous acid was not an oxygen acid, the formic acid would be represented by H(HO)CO, and the hyposulphurous acid by $HHSO_2$, in which both of the hydrogen atoms are directly combined with sulphur. He (Dr. Odling) did not see that they were obliged to retain the old formula; the question was still an open one, and he thought the facts brought forward by Mr. Schorlemmer were as explicable to the new as to the old views.

The speaker then referred to the reactions which Mr. Schorlemmer gave, both of which, he thought, could be applied to the new way with as much or more ease than to the old. In speaking about the atom of water, Dr. Odling said that if they represented hyposulphite of soda according to the old-fashioned view, they had $Na_2S_2O_3H_2O$; but he preferred to write it $2NaHSO_2$. The salt retained its atom of water with great firmness. It required a heat of 215° to drive off that atom of water from it: soda, silver, and baryta salts also required this unusually high temperature. This did not prove that the atom of water was different from water of crystallisation, but it was in favour of that view. He had said that it was impossible to drive off this atom of water, but, corrected by Mr. Schorlemmer, he would say simply that it was difficult.

Dr. Odling concluded by saying that it was a question on which he retained his mind quite open to bend in either direction as fresh facts arose, but, at the present moment, he did not think there were sufficient facts to enable them to absolutely decide the question, either one way or the other.

The PRESIDENT, in proposing a vote of thanks to Mr. Schorlemmer and Dr. Odling, thought there were two or three points brought forward by Mr. Schorlemmer which were entitled to some weight. First there was the tendency of hyposulphurous acid to form double salts of silver, sodium, &c. Among the characteristics of bibasic acids, that was one of the most conclusive, as a rule, and he (the President) thought it should weigh in Dr. Odling's mind as an argument in favour of the bigger formula. In reference to the decomposition into sulphur and sulphuric acid, it occurred to him whether there was not a difference in degree between believing that to occur by the splitting of the molecule, and believing it to occur by an action of the two molecules. There were cases which pointed to the greater facility for assuming that the result was an action in one molecule, than that it was an action of two molecules one upon another.

Mr. F. FIELD, F.R.S., then submitted a specimen of, and read a note on, sulphate of alumina from Iquique, Peru.

The following is the analysis, after deducting small quantities of chloride of sodium, oxide of iron, and silica:—

Sulphuric acid	35·56
Alumina	15·88
Water	48·56
	100·00

Corresponding to the formula $Al_2O_3, 3SO_3 + HO$, which requires—

Sulphuric acid	35·93
Alumina	15·57
Water	48·50
	100·00

Mr. W. H. PERKIN, F.R.S., then read a note "*On Regnault's Chlorinated Chloride of Methyl*," of which the following is a condensed abstract.

Last year the author read a paper before the British Association "On the Chloride of Methylene, obtained by the Action of Nascent Hydrogen on Chloroform," which was afterwards published in this journal (CHEMICAL NEWS, vol. xviii., p. 56, *Eng. Ed*). The chloride of methylene obtained from chloroform was found to boil at about 41° C., the same temperature as that at which Butlerow's chloride of methylene boils. As Regnault gives the boiling point of chlorinated chloride of methyl much lower, namely, 30·5°, the author had made a fresh examination of the substance, to see if it were an isomer of chloride of methylene. After preparing a quantity of this substance, it was found to have a boiling point of between 40° and 42° C., and apparently to be identical with the chloride of methylene from chloroform. The author, however, has not yet completed its examination. Its composition was determined by its analysis and vapour density.

The PRESIDENT, in thanking Mr. Perkin for his communication, remarked that the experiments were strictly allied to a theoretical question now at issue amongst chemists, viz., that atoms had got bonds to them which were supposed to have different properties, and, accordingly, yielded different products.

Dr. HUGO MULLER stated that he had made some experiments, with the view of finding out a good method for producing chloride of methylene; however, he found that at the best it was a long and tedious operation. The best result he obtained by simply dissolving the chloroform in alcohol, and adding hydrochloric acid and zinc with a few drops of platinum chloride. The whole is warmed slightly, in order to distil off the chloride of methylene as soon as it is formed, otherwise it is further acted upon and lost. He was trying some experiments with the object of obtaining bromide of methylene from bromoform, but the difficulty of obtaining the latter in quantity prevented him from going on with the experiment. He would be glad to hear of a practicable method for obtaining bromoform.

DR. MILLS said it might easily be obtained by treating dicitrates with an excess of bromine. He had obtained a large quantity in that way.

DR. MULLER had got, on the contrary, very unsatisfactory results with this method. The yield was very small in proportion to the citric acid used.

MR. BASSETT had prepared, or attempted to prepare, bromoform in the way described by Dr. Mills, but he also found that the yield was exceedingly small—a very poor product.

MR. PERKIN mentioned that he was at present engaged in an investigation of Bunsen's gaseous bromide of methyl.

The meeting was adjourned to the 3rd of June.

NEWCASTLE CHEMICAL SOCIETY.

A special meeting of members of the Newcastle Chemical Society was held, on May 6th, in the theatre of the Newcastle College of Medicine, for the purpose of hearing a paper read by Mr. Ludwig Mond, on "*The Recovery of Sulphur from Alkali Waste.*"

In the absence of the President, whose paper on the "Blast Furnace" was read that evening before the London Chemical Society, Mr. John Glover occupied the Chair.

The Chairman said that, as they were all aware, Mr. Mond was the patentee for the recovery of sulphur from tank waste. Of the importance of that discovery to the chemical trade of this district there could not be two opinions. He trusted that Mr. Mond would enable them, to some extent, to supply a felt want in the chemical trade in this district—namely, the profitable treatment of tank waste.

Mr. Mond, at the outset, said that thousands of pounds had been spent by chemical manufacturers to utilise the waste, or to carry it away, and no one but has had his nose offended and his appetite spoiled by going near waste heaps. In 1860, he commenced, in a chemical manufactory in Germany, a series of experiments on several processes for the recovery of sulphur from waste, and took out a patent in December, 1861. When he came to England (at the time of the Exhibition) he found, to his surprise, that a process, somewhat resembling his own, had been proposed as early as 1836. At the same time as himself, three different parties—in Glasgow, in Newcastle, and in Bristol—had been working in the same direction. His process, however, had clearly the merit of being the first that extracted great quantities of sulphur, and did away with the waste nuisance. He found the process a more expensive one in this country, where labour was dearer than in Germany. He found a difference in the English waste and that which he had been formerly accustomed to. In September of 1863, he took out the new patent. He had previously experimented on tank-waste, and had obtained as much as 55 per cent of sulphur. The first to introduce his process on the Tyne was the Tyne Chemical Company, at South Shields. He believed that the waste of this district was more suitable for using his process than that of Lancashire, as being somewhat more porous. Mr. Mond then explained, by means of a diagram, the working of his process, and exhibited specimens of the sulphur obtained from the waste. He calculated that the cost of extracting the sulphur from the waste would be £1 per ton, but the profit to manufacturers would be about £4 per ton (at Messrs. Hutchinson's, it cost £1 5s. 5d. + 15s. for royalty = £2, working on a comparatively small scale). The cost of the apparatus he calculated to be £1,509, or (providing for all contingencies) £1,660. He thought that the alkali manufacturers ought to be satisfied with the process in a mercantile point of view, and, also, as it enabled them to remove a great nuisance.

The Chairman said that, whatever might be the opinion of the meeting as to the value of the paper—and that it was of great value no one could doubt—they were under a great obligation to Mr. Mond for the trouble he had taken in bringing so important a subject so very elaborately before them. He had no doubt that some of the gentlemen present would be able to offer comments on the process; he therefore invited any comments on or criticisms of the process, as detailed to them.

In reply to Mr. Archibald Stevenson, South Shields, Mr. Mond said that the waste treated in Holland during four years had been used for a great many purposes. The new station at Utrecht had been built on waste, and a number of the houses had been built upon it. A well, used for domestic purposes, had been sunk through the alkali waste, and the water, though very hard, employed for domestic purposes.

Mr. Pattinson begged to move a vote of thanks to Mr. *Mond for his very valuable paper.* It appeared to him that Mr. Mond had solved the problem of disposing of soda waste. When the subject of utilising the waste products was mentioned to him, he had always said that the principal objection was the expense, and it was believed that the substance recovered would not pay the expense of the recovery. Mr. Mond had discovered a process by which they could recover sulphur from waste at a cheap rate; and, therefore, chemical manufacturers ought to be obliged to him for his discovery.

Dr. Lunge, in seconding the proposition, said that there were two other processes—Schaffner's process and Hofmann's process—both of which involved a very large amount of labour. They involved the removing of the waste from the vat, exposing it to the action of the air for several weeks. He was in Germany last year, and visited a chemical manufactory where Schaffner's process had been introduced. He was told by the manager that they were modifying that process, and bringing it nearer to Mond's process. Schaffner's process had been given up wherever it had been worked, and Mond's process introduced—at least as far as the blowing of air and the decomposition of the liquors were concerned. The only detail of Schaffner's process retained, was the way in which the sulphur was converted into *roll*. As to Hofmann's process, Mr. Bell had mentioned, at the last meeting, that, in his opinion, Mr. Mond's process was a decided improvement on that process.

The Chairman said that Mr. Mond's process had been alluded to in the report of the commission appointed by Government with regard to the pollution of rivers. It might be that this process could be easily adopted; and, so far as chemistry was concerned, it was easy. But they must remember that there was an increasing manufacture of bleaching powder and of bi-carbonate of soda, and that these manufactures took up the whole of the muriatic acid. The muriatic acid required in Mr. Mond's process would, therefore, be taken up in the manufacture of bleaching powder and bi-carbonate of soda. Thus, though the process was in itself valuable, seeing that it would, to a considerable extent, interfere with the manufacture of bleaching powder, its adoption for the purpose of reducing the nuisance felt from alkali waste was likely to be very limited.

Mr. Mond acknowledged the vote of thanks accorded to him for his paper, and, in reply to the remarks of the chairman, said that he would like to have an opportunity of going more fully than he would then be able to do into the question of utilising muriatic acid. As he had stated at the end of his paper, about 100,000 tons of strong muriatic acid flowed into the Tyne from alkali works during one year—or acid equal to 100,000 tons of strong muriatic acid. Believing that many manufacturers would be astonished at these figures, he explained how he had arrived at the conclusion. He found that so much salt was decomposed on the Tyne in the year, equal to so much strong acid. Now, the bleach and bi-carbonate made were also known; and, allowing quantities, very liberally calculated, for their preparation, he arrived at this remainder. The quantity of muriatic acid used for bleaching powder was considerably in excess of what was required. He believed that few manufacturers would be unable to find sufficient acid with which to treat their waste.

Mr. Scholefield thought that Mr. Mond's figures were erroneous.

Mr. Mond said these were the figures given by Mr. Richard Cail, as Secretary to the Alkali Association, who, if he had been present, might have given them better information on the question than he could supply.

Mr. Scholefield said that, if he had received information, he would have provided himself with correct details on the subject.

The Chairman thought that the figures given by Mr. Cail were likely to be quite correct.

Mr. Mond said that the quantity of acid required to do away with the waste nuisance was from 20 to 25 per cent of the acid. From 1866, the production of bleaching powder had greatly increased, but the production of bi-carbonate had

not increased; the amount produced was not at all equal to that in 1866; and it was, therefore, likely that there would be a good deal of muriatic acid to spare.

In reply to a question, Mr. Mond said that the amount of brimstone used in England was 50,000 tons a year, and that the total amount exported from Sicily was 300,000 a year.

In reply to another question, Mr. Mond said he calculated that 40,000 tons of sulphur could be utilised from alkali waste in England in one year.

The meeting then separated.

PHARMACEUTICAL SOCIETY.

Adjourned Meeting, Wednesday, May 5th, 1869.

H. Sugden Evans, Esq., *Vice-President, in the Chair.*

Mr. Carteighe recommenced the discussion of the subject introduced by Professor Redwood at the previous meeting. He did not agree with the most important practical suggestion made by Professor Redwood, viz., that in which he proposed to bend and modify the existing system of weights and measures, so as to gradually merge the one system into the other; there were great objections to such a process of bending.

The *tetram* or 4 gramme weight (one of the integers proposed by Professor Redwood) might be divided into tenths or into halves, quarters, &c., but they could not, as upholders of the decimal system, sanction the recognition of the octavial system involved in the latter. He did not think it would be easier to remember that the *tetram* was equal to one dram, and hence to four grammes, than to recognize the value of four grammes as such. He would rather suggest that a knowledge of the decimal system should be required by the Board of Examiners, and a book might be compiled as an addition to the British Pharmacopœia. The Pharmaceutical Society might also assist provincial societies in procuring complete sets of models illustrating the weights and measures of the metric system, so that any one might handle and become practically acquainted with them. It would be hopeless to expect that much could be done in a short space of time. What they wanted for the present was a plan calculated to familiarize educated men of business with the metric system.

Dr. Redwood read a letter from Mr. F. Lowe, of Liverpool, who advocated the octavial system.

Dr. Attfield considered there were immense advantages in a duodecimal over a decimal system, and an octavial was better than either, but as the world's system was a decimal one, ours should be so likewise.

Mr. Bottle, believing the system must ultimately be adopted, urged upon young men the necessity of making it an early study.

Mr. Haselden thought the system must be adopted some day, and looked to young men to make a study of it. He agreed with Mr. Carteighe in his proposal of an addition or supplement to the pharmacopœia. He would not like to see the metric equivalents added to the pharmacopœia itself, side by side with our own. He considered the adoption of the French weighing practice would be impeded by the aversion of the medical profession to making any change of the kind.

The Chairman saw no great difficulties in the way. Mr. Carteighe had referred to the fact that the Board of Examiners would require a familiarity with the metric system. He considered that the Society should procure a perfect set of weights and measures for their own museum previous to assisting provincial societies, as proposed by Mr. Carteighe.

Mr. Martindale thought there would be some difficulty in applying the system to dispensing, and in approximating metric weights and measures with the usual doses. He always found that medical students were taught the metric system in the laboratories at hospitals, and had subsequent difficulty in appreciating the value of grains, drachms, &c. He thought an octavial system was an impossibility.

Dr. Redwood thought the great defect of the present system was, that there were no integers between the grain and the ounce, and no relation between them. This had become so evident in compiling the pharmacopœia, that our present system could only be regarded as a temporary expediency. He confessed that he did not consider the metric system perfect, but he was somewhat surprised to hear he had been accustomed to condemn the system. A fault of the metric system was, that its integers had not been chosen because it was the best, but on theoretical ground; if our yard had been taken it would have been more convenient; our system is founded on experience, the metric on theory. The defects in our system must, however, be remedied, and the metric system seems to be the one generally adopted. We were the only advanced nation who had not adopted it; if we did so, it would soon become the international system. He (Dr. Redwood) thought that the difficulty would be in acquiring a knowledge of the value of its integers; to surmount this difficulty was the object of his proposals. Looking at a set of models in a museum would not suffice. He would like to have the weights marked on coin, the measures on postage stamps, &c., so as to associate the integers with objects with which we are familiar. He agreed with the proposal to enforce a knowledge of the system at the examinations, but he would only accede to the proposal to introduce weights and measures into the pharmacopœia on the condition that they were the exact equivalents. He would prefer a supplement.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of every chemical paper in the world *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Effect of Heat on the Electromotive Force of the Galvanic Battery.—M. Crova.—(*Cosmos.*)—The results obtained by the researches of this author are the following:—(1) The electromotive force of the Daniell's element decreases regularly with an increase of temperature; (2) the electromotive force of a Grove's element increases with the temperature; (3) the electromotive force of an element wherein only one liquid is applied (Smee's) is independent of the variations of temperature.

Action of Light upon Chloride of Silver.—(*Les Mondes.*)—When freshly precipitated chloride of silver (best obtained by means of decomposing a soluble silver salt with chlorine water) is placed in a white glass tube about 15 inches in length, and exposed to the action of direct sunlight, it will be observed that the chloride of silver remains quite white as long as the solution of chlorine water retains its greenish yellow colour; but as soon as that colour has vanished, the chloride of silver begins to decompose water under the influence of the direct rays of sunlight; the chloride gradually blackens, and after a shorter or longer duration of time, the whole quantity will have become black, especially if care be taken to shake the tube now and then, so as to expose the whole mass to the light. When the tube is afterwards placed in a dark place entirely excluded from daylight, the black colour of the chloride of silver again disappears gradually, and the chloride becomes white; this experiment can be repeated over and over again with the same tube. The bromide, and probably also the cyanide of silver, behave in

the same manner; the iodide of silver blackens only after having been rendered sensitive to light by pyrogallic acid.

Action of Sunlight on Glass.—M. Graffield.—(*Cosmos.*)—It is a well-known fact that, even independently from the effects of rain and wind, glass, even of good quality, is affected by sunlight. The late Dr. Faraday made some observations concerning this subject, and found that violet-coloured glass became deeper and more intensely coloured than it originally was after having been exposed to direct sunlight for eight months. M. Graffield, of Boston, U. S., who has been for more than twenty years in the wholesale glass trade, and is at the same time a good observer, has recently sent to the Photographic Society of Marseilles a series of the results of his researches and observations on this subject, in which he comes to the conclusion (which is especially important to photographers) that glass is even sensibly affected after one single day's exposure to the sun's rays, and that all glass, without exception, including that used for optical purposes, is more or less acted upon, even when made from the best materials and by most experienced workmen; greenish glass seems to become the least affected. The author has sent to Marseilles a series of photographs representing the tinge and changes produced in divers varieties and kinds of glass after exposing them to sunlight.

Adulterated Soap.—(*Les Mondes.*)—It appears that in consequence of some complaints concerning the soap supplied at the thermal establishment at Amélie les Bains, this soap was analysed. Its colour was greyish; odour very disagreeable (especially when recently cut); to the touch it was peculiarly greasy, causing a biting sensation at the same time. It was readily soluble in distilled water, producing a good lather, but the solution produced a biting pain when brought into contact with the hands. In 100 parts, the soap contained 29 of alkali and 19 of tallow; no wonder, therefore, of its effects on the skin, and complaints in consequence thereof.

Oxyhydrogen Light—Reduction of Earthy Metals.—The learned Abbé Moigno, while referring to this subject in *Les Mondes*, says, our readers will undoubtedly learn with pleasure that the production of oxygen in cheap manner from manganate of potassa and of pure hydrogen, by means of a hydrocarbon fuel (*combustible hydrocarboné*), on the large scale, has become a decided success; that, moreover, the reduction of the earths baryta, magnesia, and alumina to the metals barium, magnesium, and aluminium, by means of hydrogen under high pressure and a very high temperature, is successfully carried out; while, lastly, M. Caron has succeeded in obtaining, by means of great perseverance, zircon-magnesia cones, which, instead of being very breakable and only lasting for a few nights, are fit for use for any length of time.

Brittleness of Bones.—(*Les Mondes.*)—Professor Hofmann, at Prague, has recently analysed bones of cattle, some of which were derived from healthy animals, others, again, from animals which during life had been affected with fracture of bones consequent upon their great brittleness; while the composition of the former was normal, that of the latter proved to be abnormal, by containing a far greater proportion of carbonates and phosphates of lime and magnesia, while, at the same time, the nitrogen contained in the organic matter of the bone was considerably less than it should be; hence the Professor advised that, as a remedy in such cases, food richer in nitrogenous substances should be administered to the cattle.

Platinising Copper, Yellow Metal, and Brass.—(*Les Mondes.*)—In order to obtain the platinising fluid, add, to a moderately concentrated solution of chloride of platinum, finely-powdered carbonate of soda until effervescence ceases, next some glucose, and afterwards just so much common salt as will cause a whitish-coloured precipitate. When it is desired to apply this mixture for platinising, the objects to be treated are placed in a vessel made of zinc and perforated *with holes;* the vessel is then placed, with its contents, for a few seconds into the mixture just described, which, just previous to using, should be heated to 60° C. On being removed from the zinc vessel, the objects are to be washed with water and dried in sawdust.

Researches on Materials fit for Resisting very High Temperatures.—M. Audouin.—(*Cosmos.*)—While engaged with other studies on geology in the southern parts of France, the author found that between Tarascon and Antibes there exists a very valuable and extensive bed of *bauxite* (hydrate of alumina), which is occasionally applied for the manufacture of sulphate of alumina. This material has been applied, at the suggestion of Audouin, for the manufacture of crucibles and fire-bricks; and on having been tested in comparison with the best products of the kind from France, England, and Germany, it was found that even best fire-bricks might be melted in bauxite-made crucibles heated by mineral oils and a blast.

Synthesis of Paramonochlorobenzoic Acid.—(*Zeitschr. f. Chem. v. Beilstein.*)—Carl Müller has instituted, in the laboratory of Dr. Carius, at Marburg University, some researches on this substance. He found that paramonochlorobenzoic acid originates when chloride of benzol, C_6H_5Cl, is oxidised by the action of moderately dilute sulphuric acid and peroxide of manganese; a number of other products are simultaneously formed—among these, chiefly, formic acid. Paramonochlorobenzoic acid is a solid substance, fusible at 235° C., readily soluble in alcohol and ether, but difficultly so in water; one part of the acid requires 5288 parts of water for solution. The acid crystallises both by sublimation and from its alcoholic solution; the composition of its baryta salt is—

$$C_{14}H_8Ba''Cl_2O_4 + (OH_2)_4.$$

Its formation from chloride of benzol may be expressed by—

$$C_6H_5Cl + CH_2O_2 + O = OH_2 + C_6H_4Cl,CO,HO.$$

On the Solubility of Difficultly-Soluble Compounds in Aqueous Solutions of Sugar.—(*Zeitschr. f. Chem. v. Beilstein.*)—Dr. Jacobsthal has instituted a series of experiments on this subject, in order to ascertain the presence of various salts and their bearing upon the manufacture of beet-root sugar. The author experimented with the sulphate, carbonate, oxalate, citrate, and basic phosphate of lime, and the carbonate of magnesia; quantities of these salts in excess were placed in solutions of pure sugar in distilled water, containing respectively 5, 10, 15, 20, and 30 per cent of sugar. The salts were placed in flasks, heated for awhile on a water-bath, and left standing for from four to five days, care being taken to replace any water which might have evaporated, and also to shake the flasks daily for some time; the solutions were then filtered, and in the clear filtrate the quantity of salt dissolved was determined. The results obtained are exhibited in a tabular form, which represents—(1) the quantity of the various salts is dissolved in 1000 c. c. of the different sugar solutions; (2) the quantity of the salts which would have dissolved in the water present in the various sugar solutions, deducting the quantity of water required to keep the sugar respectively therein contained dissolved. It appears that the more a sugar solution is concentrated, the less it is capable of dissolving the salts experimented upon; the carbonate of magnesia is the only salt which makes an exception upon this rule; the results agree with some observations made by Cunze, who witnessed the separation of oxalate of lime from a sugar solution on becoming concentrated from 5 to 30 per cent.

Adulteration of Sulphuric Acid.—(*Rev. Hebd. de Chim.*)—It appears that some Continental makers of this acid are in the habit of adding to ordinary chamber acid a sufficient quantity of some cheap acid sulphate, so as to bring the sulphuric acid, as far as hydrometrical tests are concerned, up to the desired degree of density. M. Fleischer, having cause to complain about the bad quality of indigo-carmine prepared with a certain sample of sulphuric acid, was induced to evaporate some of the acid, and on doing so discovered the formation of crystals of sulphate of soda. This

kind of adulteration, however readily detected, might cause in many dye and madder and garancine works very serious loss and great inconvenience, and is a gross fraud: the inducement is the saving of the cost of evaporation and apparatus connected therewith.

On the Constitution of Glucina.—(*Zeitschr. f. Chem. v. Beilstein.*)—Dr. G. Klatzo has written, at Dorpat University, an essay on this subject, and conducted a series of experiments with oxide of glucinum, and prepared a large number of salts and double salts of this base. He has made several analyses of sulphate of glucina, and calculated from the results thus obtained the percentage of oxygen contained in the glucina at 63·425 per cent, the atomic weight of BeO at 25·227, and the atomic weight of Be at 9·227. As general results of his researches, the author states—1st, that glucina is in every respect a base similar to magnesia, which it can displace without change of crystalline for mand quantity of water of crystallisation; 2nd, the sulphates of glucina, heated to 150° C., still retain one atom of water, which, as is equally the case with magnesia salts, can be displaced by sulphate of potassa; 3rd, like magnesia and oxide of zinc, glucina crystallises from its solution in excess of water saturated with carbonic acid, and yields a neutral crystalline carbonate, capable of forming, with the carbonates of the alkalies, perfectly crystallising double salts.

Journal für Praktische Chemie, 1869, No. 2.—This number contains the following original papers:—

Researches on some New Minerals.—M. R. Hermann, having the opportunity of sorting a parcel of minerals from Nishny-Tagilsk, Russia, found among these one which, in consequence of its outward similarity to copper lazurite, *kupferblau*, attracted his attention. On testing it qualitatively, however, he discovered that, unlike the mineral just named, the substance he had to deal with contained, besides silica, oxide of copper, and water, also a large quantity of phosphoric acid. The mineral was named by him *cyanochalcite;* it is a tough substance, its fracture is even, it is transparent at the edges, has a sky-blue colour, its hardness is 4·5, and its specific gravity 2·79; on being heated, it loses water and becomes black; before the blowpipe it gives the reactions of copper; is readily soluble in hydrochloric acid, does not effervesce with acids, while on becoming dissolved silica is separated in the shape of a powder; molybdate of ammonia added to its solution indicates phosphoric acid. Results of analysis gave, for 100 parts:—Silica, 26·90; phosphoric acid, 6·95; oxide of copper, 49·63; water, 16·52. The genuine copper lazurite contains 45·5 per cent of oxide of copper, but no phosphoric acid at all. Hydrargillite, from Chester county, U.S.:—Hardness, 3·0; specific gravity, 2·35; infusible before the blowpipe. Contains in 100 parts:—Phosphoric acid, 0·91; alumina, 63·84; water, 33·45; silica, 1·50; and traces of magnesia and peroxide of iron. Wavellite, from the same county, contained:—Phosphoric acid, 32·70; alumina, 35·83; water, 28·39; peroxide of iron, 3·08; and a trace of fluorine. The hardness of this mineral was 3·5; its specific gravity 2·30.

Acetonic Acid.—This acid is prepared in the following manner:—Aceton, hydrocyanic acid, and dilute hydrochloric acid are mixed, and then left standing together for three weeks; after this time the mixture is boiled on a water-bath for three days in a retort or flask with a condenser attached to it, and so arranged as to admit of the reflux into the retort of the greater part of the condensed liquid; the residue is then treated with ether. After evaporation thereof, a sour yellow extract-like substance is obtained, which contains acetonic, formic, hydrochloric acid, and still a little hydrocyanic acid; this mass is again concentrated by evaporation, then diluted with water, boiled, and while boiling neutralised with carbonate of zinc. After filtration the filtrate yielded acetonate of zinc; this was diffused through water, and the zinc removed by sulphuretted hydrogen, the sulphide of zinc having been separated by filtration, the acid after a time was obtained in solid crystals by slow evaporation. It is a solid, very readily soluble in water, alcohol, and ether; it sublimes when quite dry, and fuses at 79° C. The acetonate of zinc is a difficultly soluble salt, which contains 24·59 per cent of zinc.

On a Constituent of the Resin from the Ferreira Spectabilis.—It appears that in the Brazils there is in use, as a febrifuge, a resin, known in some parts of the country as *sulphato*, in others as *Resina d'angelim pedra*. When this resin is first digested with water, which removes colouring matter, the residue dissolved in water acidulated with hydrochloric acid, and the crystals thereby obtained first purified with water, next with absolute alcohol, again dissolved in hot water, and this solution treated with ammonia, a substance is precipitated which has been named *angelin;* this material had been sent from Cantagallo to Vienna, and was thence forwarded to Prague, to Dr. Gintl, for examination and report. That gentleman, after very exhaustive qualitative and quantitative researches, found, on elementary analysis of the frequently purified substance, that it consists, in 100 parts, of:—C, 61·51; H, 6·81; N, 7·26; O, 24·42; formula—

$$C_{19}H_{13}NO_3.$$

Dr. Gintl further found that angelin is in all respects identical with Runge's ratanhin, also in its behaviour with nitric acid, by which both these substances are first made rose, next ruby-red, and finally deep violet coloured, provided only dilute acid be applied, and heated very gradually and gently.

On a Combination of Hydrate of Phenyl and Carbonic Acid.—M. Barth caused some porous substances to become impregnated with the hydrate of phenyl, and placed these in the iron vessel belonging to Natterer's apparatus for condensing carbonic acid; he then condensed some of that gas in the said vessel, and, on inspection after a few days, he found that the phenyl-alcohol had been converted into a mass of crystals very like those which the cubes of common salt form when agglutinated together. Barth found that these crystals contained carbonic acid, and a series of quantitative experiments proved the quantity of that gas to be from 5 to 5·5 per cent; the crystals fused at 27° C. on exposure to air, and very frequently were forced asunder with a sharp report; when one breathed over these crystals, they became covered with a slight foam. The compound is represented by the formula—

$$8C_6H_6O + CO_2.$$

Bulletin Mensuel de la Société Chimique de Paris, March, 1869.—This number contains the following original articles:—

Researches on the Milky Juice of the Antiaris Toxicaria.—Dr. De Vry and M. E. Ludwig have made researches on this substance, the produce of a tree which grows wild in Java, the juice of which, here alluded to, is applied by the natives to poison arrows; the specific gravity of the juice is 1·06; on evaporation it leaves 37·9 per cent of a brown resin. This resin, treated with warm petroleum (boiling at 60°) and with absolute alcohol, leaves 47 per cent of substances insoluble in these fluids; the petroleum dissolves an amorphous, and also a crystallisable resin, some fatty matters, and caoutchouc. The alcoholic extract contains antiarine, an acid, and a saccharine substance, while the insoluble portion is albumen. The antiarine is a glucoside, which can be split up into sugar and a yellow resin; its composition in 100 parts is expressed by—C, 61·2; H, 8·1; O, 30·7. The crystallisable resin, differing from the resin antiar described now about forty years ago by Mulder, contains in 100 parts—C, 83·9; H, 11·9; O, 4·2.

On the Colouring Matters of the Anthracen Series.—MM. Graebe and Liebermann have found that when purpurine (extracted from madder root) is heated with powdered zinc, anthracen is obtained identical to that which alizarine yields when distilled with zinc. When purpurine is treated with reducing substances it yields, as also does

alizarine, a colourless substance, which oxidises in the air, and then yields again purpurine. From these and other reactions the authors infer that purpurine is oxyalizarine, or trioxyanthraquinone—

$$C_{14}H_5\begin{cases}(HO)_3\\O_2''\end{cases}$$

Chrysophanic acid has been considered by Rochleder as represented by—

$$C_{10}H_8O_3,$$

while Gerhardt expressed its constitution by—

$$C_{14}H_{10}O_4;$$

this acid yields, with nitric acid, chrysammic acid, which, according to the authors of this paper, is tetranitroxyanthraquinone—

$$C_{14}H_2(NO_2)\begin{cases}H_2O\\O_2''\end{cases}$$

Aloine, treated by powdered zinc, has also yielded anthracen; aloine yields chrysammic acid when treated with nitric acid. Gentianic acid—

$$C_{14}H_{10}O_5,$$

and euxanthone—

$$C_{20}H_{12}O_6,$$

have been likewise treated by zinc; these acids did not yield anthracen, but other hydrocarbons.

Iron in Milk.—M. Bistron has found that the milk of the female goat contains on an average 0·1 grm. of iron in 1,000 parts of milk; this quantity of the metal appears to be constantly present in that fluid, and corresponds with the quantity found in the milk of women.

On the Application of Alkaline Iodides as Reducing Agents.—M. Berthelot read a short paper on this subject at the meeting of the Paris Chemical Society, relating his experience in this respect, and stating that though iodide of potassium is in many instances more preferable to use than hydroiodic acid, it is less active than that substance. The same applies to iodide of ammonium; this is explained by the author to be caused by the greater stability possessed by these compounds.

On the Use of Protoxide of Thallium as an Ozonoscopic Substance.—M. Lamy communicated, at the meeting of the Society, the following observations made by him concerning this subject as the result of a series of experiments made during a year, not only in Paris, but in divers parts of France, including some remote mountainous districts:—(1) Protoxide of thallium assumes a brownish tinge, even when out of reach of any air or ozonised oxygen; (2) the sensitiveness of the thallium paper varies according to the degree of concentration of the solutions which have been applied in preparing it, or their more or less advanced state of carbonatation; (3) recently prepared thallium paper is more sensitive to ozone than paper prepared with starch and iodides; (4) the more or less dark colour of the thallium paper only, then, indicates ozone when that same paper afterwards renders tincture of guaiac blue when moistened with that fluid; (5) when this condition is properly attended to, protoxide of thallium paper is very fit to indicate rapidly and with certainty ozone, even in an atmosphere containing nitrous acid fumes; but this paper can only serve as a reagent for ozone, and is not fit for showing any quantity thereof in the atmosphere.

On the Action of Light upon Sulphide of Carbon.—Many of our readers have had the opportunity of noticing that the bottles, especially if made of white glass, containing sulphide of carbon often become lined, if exposed for any length of time to direct sunlight, with a coating strongly adhering to the glass. M. Loew has experimented on this substance, by enclosing the sulphide in sealed glass tubes previously moistened with water, which has the effect of lessening the adhesiveness of the brownish coating. On *opening* the sealed tubes after a few months' exposure to sunlight, the water was observed to have an acid reaction, due to the formation of some formic acid; the solid substance alluded to is insoluble in alcohol, chloroform, ether, and sulphide of carbon, but soluble in a boiling solution of caustic potassa, becoming, however, at the same time decomposed. The substance is sesquisulphide of carbon, which, on being submitted to distillation, is decomposed, yielding sulphur and carbon; the sulphide of carbon from which this substance is deposited contains sulphur in solution, though perfectly pure previous to exposure to sunlight.

Estimation of Suboxide of Copper occurring in Metallic Copper, and especially in the Variety of this Metal Known as Rosette.—When dilute sulphuric acid acts upon suboxide of copper in the presence of nitrate of silver, the suboxide is split up into metallic copper and oxide of copper, which becomes dissolved as sulphate, while the metallic copper takes the place of the silver of the nitrate of that metal. In order to apply this reaction for analytical purposes, M. C. Aubel takes 0·5 gramme of the copper to be tested, previously reduced, by proper mechanical means, to powder or filings; he adds 1·3 grm. of solid nitrate of silver mixed in a mortar with 10 c.c. of dilute sulphuric acid. The decomposition sets in at once, and is entirely complete after two hours' time; water is then added, the metallic silver is collected on a filter, well washed, and, after having been dried, is weighed.

Volumetrical Estimation of Chromic Acid.—M. C. Zulkowsky adds to the chromic acid solution a sufficient quantity of iodide of potassium, free from iodate, and pure hydrochloric acid. This mixture is left quietly standing for from half an hour to a few hours' time, according to the degree of concentration of the solution, for in no case is the reduction of the chromic acid by means of the hydriodic acid instantaneously effected. When the reduction is complete, which may be learned from the pure green colour the liquid has assumed, a small quantity of thin starch paste is added, and the quantity of iodine which has been set at liberty is estimated by titration with a solution of hyposulphite of soda. Quantitative test solutions are prepared by dissolving 24·8 grms. of hyposulphite of soda in a litre of water, and 4·9196 grms. of bichromate of potassa also in a litre of water; by this arrangement 1 c.c. of the first solution is equal to 1 c.c. of the chromate solution containing exactly 0·003349 grm. of chromic acid.

Testing Sulphate of Quinine.—M. Panot applies, for the purpose of ascertaining the presence of salicine in sulphate of quinine, the well-known action of oxidising substances upon salicine, and the transformation of the hydride of salicyl into a substance which, under the influence of perchloride of iron, assumes a bluish violet colour. The suspected sulphate of quinine is placed in a flask, to which, by means of a perforated cork, a glass tube can be fixed; then 2 c.c. of dilute sulphuric acid (1 of acid upon 4 of water), and 4 c.c. of a saturated solution of bichromate of potassa, are poured into the flask; heat is applied to the flask, and its contents brought to boiling, while the products of the distillation carried off by the glass tube are collected in distilled water. When the reaction ceases, some few drops of a solution of chloride of iron are added to this distilled water, and, should a violet colouration ensue, this will be evidence of the adulteration with salicine of the sulphate of quinine; the presence even of ½ per cent of salicine is very readily proved by this process.

On the Characteristic Differences and Tests for the Detection of some Fatty Oils.—Dr. Sacc, of Neufchâtel (*Rev. Hebd. d. Chim.*, No. 22, 1869.)—Although the fatty oils are nearly all compounds of fatty acids and glycerine, there exists among them so much difference of physical properties that there is good cause to assume that the diversity of taste and the colour and odour exhibited by these oils is due to very slight differences in chemical characters, and hence behaviour with reagents, which the author has endeavoured to find out, and thereby render the detection

of adulteration a more easy matter. *Olive oil.*—Colour light yellow, odour faint; heated to nearly its boiling point it decrepitates, in consequence of having retained slight traces of water, and becomes discoloured without further change. A mixture of equal bulks of oil and of nitric acid of 1·31 sp. gr. at 55° F. does not at the ordinary temperature produce any change. Sulphuric acid of 1·76 sp. gr., and at 55° F., unites with the oil, the mixture becomes hot, dark coloured, and, on addition of cold water, the dark mass, while dissolving therein, becomes white. Commercial acetic acid has no action whatever upon the oil; caustic soda lye of 1·04 sp. gr. at 55°, produces, even in the cold, a white emulsion; alcohol of 90 per cent floats on the oil, but does not dissolve it. Ether, benzol, light petroleum, naphtha, sulphide of carbon, and spirits of turpentine dissolve the olive oil and all the following oils. A solution of nut-galls, of 100 grammes weight of galls to the litre of water, does not change olive oil when mixed therewith; this reaction enables us to distinguish between ground-nut and sesame oil, with both of which olive oil might be confused. Caustic ammonia readily forms a beautifully white emulsion with this oil, which is not at all acted upon by solutions of nitrate of silver and chloride of gold. *Colza oil.*—Golden yellow colour, faint odour, somewhat resembling that of turnips; when heated to boiling point its colour becomes lighter. Nitric and acetic acids do not act upon this oil; sulphuric acid, when mixed with this oil, evolves much heat, while a dark-brownish mass is formed, which, on being dissolved in water, becomes white; caustic soda solution and liquid ammonia form emulsions with colza oil, which is insoluble in strong alcohol and specifically heavier than that fluid. Solution of nut-galls forms an emulsion, and the same is also the case with chloride of gold and the oil; nitrate of silver causes a turbidity in the oil, and appears to become partly reduced to metal. *Oil from Arachis hypogœa: Ground nut oil.*—Light straw-yellow colour; odour faint; no change when heated to boiling point, and becomes turbid and more dark-yellow coloured on addition of nitric acid; addition of sulphuric acid evolves much heat and changes it, as did the same acid when added to colza oil; with soda solution and with solution of nut-galls the same behaviour as the foregoing, ammonia also as the foregoing, and alcohol the same; no action with nitrate of silver, while chloride of gold forms an emulsion with this oil, and becomes partly reduced to the metallic state, perceptible by a violet colouration. *Nut oil.*—Bright lemon yellow; odour acrid; heated, it boils quietly, and its colour becomes less deep; is rose-coloured by nitric acid, but the colour disappears very rapidly, and a slight turbidity is produced; with sulphuric acid a great heat is developed, and the oil obtains a cinnamon-brown colour; the mixture swells upon being placed in water, becomes white, and a portion of oil which had not been apparently acted upon floats on the top of the water. Acetic acid, soda solution, and solution of nut-galls do not act upon this oil at all; alcohol does not dissolve it and floats on it; nitrate of silver causes a slight turbidity, while chloride of gold is readily reduced by the oil. *Whale oil.*—Dark yellow coloured; odour very disagreeable and nauseous; on being heated, the oil boils readily and without spurting; nitric acid produces a bister colouration; sulphuric acid develops very little heat, and causes a cinnamon-brown colouration. When the mixture of this acid and oil are placed in water it becomes white and disengages an odour somewhat resembling that of asphalt. Acetic acid and solution of nut-galls are without action upon this oil; with soda solution a yellow emulsion is formed; alcohol does not dissolve it; liquid ammonia forms a yellow emulsion; nitrate of silver, no action; chloride of gold, traces of reduction. All the reactions before mentioned have been made with equal bulks of oils and reagents in test-tubes at a temperature of from 15° to 20° C., and the substances have been left in contact for thirty-four hours; this also applies to the following experiments:—*Cotton seed oil* (of course refined).—Bright orange yellow colour, faint odour, no change on being boiled; becomes brown at the points of contact when treated with nitric acid. Sulphuric acid causes evolution of much heat, changes it into a brown mass, which, on being placed in water, becomes white and dissolves therein; acetic acid and nitrate of silver have no action upon this oil; solution of soda and liquid ammonia form emulsions with difficulty with the oil, which is itself insoluble in alcohol; solution of nut-galls causes an emulsion, as does also a solution of chloride of gold, which is, moreover, perceptibly reduced to the metallic state. *Sesame-seed oil.*—Colour bright yellow; odour faint; becomes nearly colourless when heated to boiling point. With nitric acid, bright orange colour; with sulphuric acid, evolution of heat, dark brown colour, and, on addition of water, violet colour, and soluble therein (it should be observed that sulphuric acid really saponifies most of these oils, and that the soap so formed is soluble in water added in excess); acetic acid, no action; with soda, ammonia, and nut-gall solutions, emulsions are formed, all of which exhibit a white colour; not soluble in alcohol, and thickens on addition of nitrate of silver. Chloride of gold causes formation of an emulsion, and is itself perceptibly reduced to the metallic state.

Annalen der Chemie und Pharmacie, April, 1869.

The following are the original papers which appear in this number:—

"*On Salicyl Compounds*," by Schröder and Prinzhorn.—"*On Propylphycite and some Substances allied thereto*," by J. G. Wolff.—"*On a New Method of the Formation of Glycogollamide, and on the Constitution of Urea.*" by Heintz.—Second part of lengthy treatise of A. Lieben's "*On the Synthesis of Alcohols by Means of Chloruretted Ether.*"—Reply from A. Strecker to M. Maly's criticisms on Strecker's paper "*On the Identity of the so-called Abietinic Acid and Sylvinic Acid.*"

The above papers are treatises and essays rather than papers, and are so concisely written as to be unfit for condensation.

Moniteur Scientifique, No. 297, 1869.

The Use of Bran in Brewing, Manufacture of Spirits and Starch Making.—Since bran contains from 40 to 60 per cent of its weight of starch (farine), M. Poncelet proposes to use a certain quantity of bran instead of malt or raw grain for the purposes of brewing, making spirits from grain, and the manufacture of starch. He either uses the bran as it is, or extracts the starch from it previously, and adds this substance to the materials required for the mash-tubs.

The Substitution of Alum-shale for Bone-Black in Sugar Manufacture.—M. Belin proposes to do away with the use of animal charcoal for sugar manufacturing purposes, and to substitute instead the exhausted alum-shale after it has been applied to the manufacture of alum, or sulphate of iron. 100 parts of juice from beet-root require from one to eight parts of the exhausted shale. The liquid, after having become clarified, is evaporated to 26 degrees Beaumé in contact with air without any previous filtration, and next concentrated in vacuum pans to 43 degrees. The concentrated syrup thus obtained is run into large iron tanks and left to crystallise. The only advantage gained by this process is, beside the saving of animal charcoal, the obtaining of molasses better fit for the distillery of spirits usually connected with beet-root sugar works.

Sulphurous Acid for Dissolving Bones.—It is well known that hydrochloric acid is used for the purposes of dissolving the earthy salts of bones, in order to obtain the gelatine they contain in such a state as to render that substance readily soluble in boiling water. The use, however, of hydrochloric acid is rendered rather inconvenient for this purpose, on account of the formation of chloride of calcium which interferes with the drying of the gelatine. M. Coignet, at Paris, has found that sulphurous acid answers the purpose of hydrochloric acid in this instance perfectly well.

[*English Edition*, Vol. XIX., No. 493, page 238; No. 494, page 249.]

The bones are placed in cold water, and through the water a current of sulphurous acid gas is forced so long as is required to completely soften the bones, which are afterwards washed in fresh water wherein some sulphurous acid gas has been previously dissolved.

Les Mondes, May 6, 1869.

Oxyhydrogen Light.—The following description is given of the experiments which are every evening made at 44, Rue Lafitte, Paris, with the above-named light:—The burner, which is arranged to burn either pure hydrogen gas or coal gas at any pressure from 2 millimetres up to several centimetres, is constructed in the following manner:—The oxygen issues from a central opening, the hydrogen or coal gas issues from small tubular openings, not unlike those met with in the Leslie gas-burner; but instead of being as in that burner almost vertical, they are in this instance bent so as to lay almost horizontal, and thus stand with the openings opposite to each other, while the oxygen is in the centre; the flame is directed against a piece of zircon-magnesia. We further notice a circular Argand burner without any magnesia cone, and so arranged as to have the combustion of the gas supported by oxygen gas instead of by air. A modification of this burner, as regards the arrangement of the supply tubes, is made to serve for burning gas fed by oxygen, the burner being placed in strong glass globes so as to suit the purposes of lighting mines and for submarine lamps. Care has been taken by proper and suitable means to carry off the products of the combustion in each case in such manner as to insure the safe use of the apparatus.

Bulletin Mensuel de la Société Chimique de Paris, No. 4, 1869.

This number contains the following original papers:—

Discovery of a New Base.—M. Wurtz has succeeded in obtaining a new base by making chlorhydrate of glycol act upon toluidine at a temperature of from 200° to 220° C. This substance exhibits a beautifully green fluorescence, has a bitter taste, is precipitated by a solution of iodine in solution of iodide of potassium. It contains H_2 less than toluidine, while for two other hydrogen atoms are substituted a vinyl and hydroxethylen group. The chloroplatinate of the base is a crystalline substance readily decomposed by heat.

Two replies, rather than papers, by Messrs. Fittig and Wurtz, to criticisms made upon their work are of no particular interest. Concluding portion of Berthelot's paper "*On the Universal Method of Reducing the Hydrogen of Organic Compounds.*" "*On the Detection of Sulphur by the Spectroscope*," by M. Salet. This is a re-discovery of Mr. Barrett's researches on this subject published some years ago in the *Philosophical Magazine*.

On a Substance Homologous with Borneo Camphor.—The substance known in perfumery and pharmacy as patchouli camphor is, according to recent researches of M. Gal, a substance homologous with Borneo camphor, which is represented by $C_{30}H_{22}O_2$. The average results of several elementary analyses of patchouli camphor gave for 100 parts:—C, 80·1: H, 12·6; the formula just quotod requires C, 80·3: H, 12·5; the vapour density of this substance taken at 324° is 8·00; patchouli camphor is solid, fuses between 54° and 55°, and boils at 296°; its specific gravity is 1·051, at a temperature of 4·5° C. The camphor is insoluble in water, readily soluble in alcohol and ether; it crystallises in hexagonal prisms. While Borneo camphor is a right-handed rotatory substance, the patchouli camphor is left-handed. When patchouli camphor is distilled with chloride of zinc at between 248° and 252° C., it yields a carbide of hydrogen, $C_{30}H_{26}$. The essence of patchouli is isomeric with the camphor, which is, it appears, simply formed by a molecular change.

On the Acetone of Formic Acid.—M. E. Mulder instituted the following experiment in order to prove that methylic aldehyde and aceton are identical, and must be both expressed by the formula, H,CO,H_3. The author has submitted formiate of lime to distillation, and has obtained a liquid which reduces silver salts to metal readily, and is, moreover, possessed of all the properties of Hofmann's methylic aldehyde.

On Nitroglycerine.—M. Tilberg has made some researches on this substance, making use of the nitroglycerine manufactured on the large scale at Stockholm. This material is decomposed by potassa, giving rise to the formation of nitrate of potassa and glycerine; but, at the same time, there are formed secondary products, as ammonia, cyanogen, oxalic and ulmic acids, and nitrous acid. According to the results of elementary analysis made by the author, the formula for this kind of nitroglycerine should be $C_3H_5(N_2O_2)O_3$. The substance is soluble in concentrated sulphuric acid, yielding a clear solution, and forming a sulphoconjugate which, on being combined with bases, gives crystallisable salts.

On some New Combinations of Orcine.—M. V. de Luynes observed that orcine combines directly with picric acid, when that acid is mixed with water in too small a quantity to admit of its solution. On raising to the boiling point, orcine is added gradually until all the picric acid has disappeared. On cooling, crystals are deposited which have the appearance and colour of bichromate of potassa. These crystals are deliquescent, soluble in water, alcohol, and ether, and decomposed by benzol, which takes up the picric acid and leaves the orcine. They are represented by the formula—

$$C_{12}H_3(NO_4)_3O_2, C_{14}H_8O_4 = C_{26}H_{11}N_3O_{18}.$$

Orcine combines directly with nicotine, forming a rose-coloured solution. When previously fused orcine is placed under a bell-jar filled with gaseous oxide of ethylen, the gas is absorbed, and the orcine liquefied. An aqueous solution of orcine dissolves rosaniline, partaking of the colour exhibited by the solutions of that substance. It would appear that orcine also combines with common salt.

A New Compound of Lime and Sugar.—Messrs. Boivin and Loiseau have formed a new combination of lime and sugar which, moreover, contains carbonic acid. It is prepared in the following manner:—To 200 kilos. of syrup containing 60 per cent of crystallisable sugar, 120 kilos. of caustic lime as a thickish milk of lime are added, and next carbonic acid gas is passed through the mixture. After some time a precipitate is formed, and as soon as it makes its appearance, 20 litres of tepid lime water are added, and the stream of carbonic acid gas is stopped. The precipitate just alluded to is the new compound, and it contains in 100 parts, 43 of sugar, 40 of lime, and 17 of carbonic acid.

Fluosilicic Acid for Sugar Refining.—It appears that M. Marix has taken in France a patent for the application of fluosilicic acid for the purifying of beet-root and other saccharine juices. The saccharine fluids are first diluted with a sufficient quantity of water to take away the viscosity of these fluids, sufficient fluosilicic acid is then added to precipitate all the potassa salts present, and next powdered chalk is added to saturate any excess of the acid. The fluid is then filtered in order to obtain a clear liquid, and this afterwards treated in the usual manner.

Bleaching Paper Pulp.—M. Gauny proposes to bleach paper pulp by means of bichromate of potassa. For 100 kilos. of pulp (supposed to be dry) he uses 50 kilos. of bichromate and 150 kilos. of hydrochloric acid, mixed with a sufficient quantity of water to make the pulp float. After twelve hours' standing, the chloride of chromium is washed out by means of clean water, and the pulp treated with a small quantity of bleaching powder to make it thoroughly white. The chloride of chromium is precipitated by means of excess of lime, and this mixture is calcined in a reverberatory furnace, where it is converted into chromate of calcium.

Many of the papers and short notices in this periodical appeared some years ago in the CHEMICAL NEWS. Some are eleven years old.

Journal für Praktische Chemie, No. 3, 1869.

This number contains the following original articles:—

Extraction of Zinc from its Ores by the Wet Way.—It appears that, in consequence of the scarcity of fuel, and the poverty of the main bulk of the zinc ores now found in Silesia, Prussian Empire, M. O. Jungkann has been making experiments to try to find a method of extracting from the ore there found the zinc it contains in a quantity of from 7 to 10 per cent, by the so-called moist way; the ore is calamine stone, or carbonate of zinc mixed with impurities, as oxide of iron, sand, alumina, lime, and magnesia. Liquid ammonia, chloride of ammonium, and hydrochloric acid were tried, but did not, for various and local reasons, answer the purpose. The author next tried chloride of calcium; this he found to answer as well with the soft residue of washing the ore schlich, containing only from 4 to 10 per cent of zinc, as with lumps containing from 20 to 27 per cent thereof; the result is that a nearly concentrated solution of chloride of calcium and boiling heat are required, but then the extraction is complete and far less expensive than with fuel, and the material obtained is readily reduced by the ordinary method of zinc smelting.

On Oxysulphobenzid.—Dr. L. Glutz has made a series of experiments which induce him to call phenol not an oxyhydrate, but an oxyhydrocarbon; this opinion is based upon the change which phenol undergoes when it is converted into oxysulphobenzid. This substance—

$$\left.\begin{matrix}C_{12}H_5O_2\\C_{12}H_5O_2\end{matrix}\right\}S_2O_4$$

is obtained when 1 equivalent of phenol is heated to 160° C. with 1½ equivalents of strong sulphuric acid, the mixture poured into water, wherewith the crystalline mass thus obtained is thoroughly washed; it is next purified by dissolving it in ammonia, and precipitated from this solution by means of hydrochloric acid. The oxysulphobenzid is almost insoluble in cold water, readily soluble in alcohol and ether; it crystallises from its solution in boiling water, forming needle-like crystals; it is not affected by a high temperature, but it is difficultly sublimed; on being heated to redness it first melts, next burns off, leaving a difficultly combustible coal. It is a weak acid, and readily soluble in the alkalies and their carbonates; it combines as well with acids, and very readily with nitric and acetic acids, but these compounds can only be formed indirectly. The author considers this substance to be an oxyaceton of the sulphuric acid series—that is to say, a derivative of a bibasic sulphuric acid, the extra radical oxygen atoms of which have been replaced by oxyphenyl.

On Mercury Naphthyl.—MM. Otto and Möries have instituted some researches on this compound, which was obtained by treating bromonaphthalin, boiling at between 277° and 278° C., with coal-tar oil boiling at 220° to 140° C., with pasty sodium-amalgam; heat was applied, and the mixture brought to boiling and filtered while hot; on cooling, the filtrate deposited the mercury-naphthyl in small yellow crystals, which were purified by repeated re-crystallisation from solutions in benzol or sulphide of carbon. The mercury-naphthyl—

$$\left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\}Hg$$

exhibits small colourless prismatic crystals, not changed in the air or light, without smell, insoluble in water, sparingly soluble in alcohol, more readily soluble in warm benzol, sulphide of carbon, and best in chloroform; it fuses at 243° C., and is not quite volatile without becoming simultaneously decomposed. Heated with soda-lime, it yields mercury, naphthalin, and a hydrocarbon melting at 133° C.; the haloid hydrogen acids decompose it into naphthalin and the respective haloid salts of mercury. When moistened with alcohol, sulphuretted hydrogen does not affect it at all; fuming nitric acid converts it into nitrate of mercury and a nitro-substitute of naphthalin. Dissolved in sulphide of carbon it combines with iodine, forming biniodide of mercury-naphthyl.

Zeitschrift für Chemie, von Beilstein, No. 5, 1869.

This journal contains the following original articles:—

On the Decomposition of Grape Sugar in Alkaline Solution by Oxide of Copper.—It is well known that some years ago it was stated by Reichardt that gum and gummic acid ($C_6H_5O_{10}$) were the products of this reaction. M. A. Claus has endeavoured to control this statement by making a new series of researches on this subject; he reduced about 80 grms. of oxide of copper (equal to 36 grms. of sugar) at a temperature between 12° and 14° C., filtered the liquid, acidified it with acetic acid, and precipitated with acetate of lead; the precipitate thus obtained was carefully washed, next decomposed by means of sulphuretted hydrogen, the sulphide of lead removed by filtration, and the fluid somewhat evaporated at a temperature not exceeding 40° C. After removal of the HS, the fluid was divided into two equal portions, one of which was precipitated with chloride of calcium, the other with chloride of barium; the precipitates thus obtained were, after having been dried at 100° C., perfectly white, but not crystalline. The salts were analysed, and the result was, that not gummic acid, but oxymalonic acid, is formed; but this acid is no more the chief produce of this reaction than is gummic acid. The quantity of oxymalonic acid is only small; at the same time oxalic, formic, and acetic acids are generated. The quantity of oxymalonic acid obtained in free state was too small for full investigation of its properties.

Oxidation of Acetic into Oxalic Acid.—Dr. F. Lossen states that when one part of acetate of soda, one part of hydrate of soda, and two parts of permanganate of potassa are dissolved in a little water, the solution concentrated by boiling, and next brought to dryness at a temperature at which oxalic acid is not decomposed, and this heating continued until a small test-portion ceases to yield, with water, a green-coloured solution, oxalic acid can be readily proved to exist in the remaining saline mass.

On the Constituents of Peru Balsam.—M. Delafontaine has recently taken up this subject again for his experimental researches. He obtained a substance known as cinnamein, which, however, appears to be a mixture of cinnamic-benzyl ether and cinnamate of cinnamic ether; this cinnamein boils at 305° C., but is then, also, partly decomposed, leaving a resinous residue, while, when the operation is pushed rather rapidly, inflammable gases are also given off. In order to prevent any secondary decomposition, a portion of cinnamein which had not been submitted to any heat at all was saponified in the cold with an alcoholic solution of caustic potassa, and the result of this operation treated with water; this dissolved cinnamate of potassa and an oil was set free, which, by means of fractional distillation, was separated into benzyl alcohol (boiling at 205°) and cinnamic alcohol (boiling at 222°); this latter was colourless, very fluid, and the quantity obtained thereof was about half that which was obtained of benzyl alcohol. The results of the researches made by Plantamour on this subject about thirty years ago were the same. The chief mass of the balsam is therefore cinnamein, but it also contains variable quantities of other substances, among these toluol and some ethereal oils not properly known in separate state.

On the Estimation of the Value of Indigo.—M. George Leuchs estimates the indigo-blue, the chief and only valuable constituent of the drug, in the following manner:—By means of 35 grms. of lime and 30 grms. of protosulphate of iron, 10 grms. of indigo are dissolved in 3 litres of water. In order to exclude the access of air, some petroleum was poured on the top of the fluid; (this fluid, however, was simply used as one to experiment with), and the experiments lead to the result that equal portions of this solution reduce equal quantities of peroxide of iron, and that this reaction proceeds as expressed by—

$$C_{16}H_6NO_2+Fe_2O_3=2FeO+C_{14}H_5NO_2+HO.$$

In order to test any sample of indigo, 1·31
so mixed with lime and sulphate of iro

tion measuring 300 c.c., which should be placed in a tall cylindrical glass vessel provided with a well-fitting glass stopper. To 100 c.c. of the solution thus obtained, 66⅔ c c. of a solution containing 1-10th of iron alum acidulated with sulphuric acid are added; the fluid so obtained is filtered, and 100 c.c. of the filtrate are taken and titrated with a solution containing 1-10th of bichromate of potassa, which is best run into the indigo containing fluid from a burette having divisions of ½ c.c., in which case every division is equal to 1 per cent of indigo-blue.

No. 6, 1869.

On Cyanphenylen.—M. W. Irelan states that, when bromophenylsulphate of potassa and cyanide of potassium are intimately mixed, and after having been placed in a glass retort submitted to destructive distillation, a white substance is sublimed at the neck of the retort. It is a compound expressed by the formula $C_8H_4N_2$; it is, in fact, cyanphenylen, a substance possessed of a pleasant aromatic odour, insoluble in warm, as well as in cold water, difficultly soluble in boiling alcohol, and pretty readily sublimed by application of heat. Boiled with strong caustic potassa, it evolves ammonia, and is changed into an acid which, by its properties and composition, is terephthalic acid.

On Ethyldiphenol.—M. Burr states that when one atom of ethylenbromide, and two atoms of finely powdered phenolide of potassium, are heated together in a sealed tube at 140° C., bromide of potassium is formed, and an oily substance, which, on being first treated with water to separate it from the salt just alluded to, is readily soluble in ether, and, on the evaporation of that fluid having taken place, is left as a solid crystalline substance. Its formula is $C_{14}H_{14}O_2$; it is devoid of taste and smell, insoluble in water, soluble to some extent in alcohol, very readily and largely soluble in ether, fuses at 98·5° C., and becomes solid again at 92·5° C. On being heated on platinum foil it takes fire and burns off, giving a strongly sooty flame; on being heated with nitric acid, it is converted into a deep yellow mass of needle-like crystals, which is soluble in ether, and exhibits acid properties.

On Chlorethyl-sulphuric Acid from Chlorethyl-Chloride.—M. Kind has made some experiments with the view to ascertain whether the simply-chloruretted chloride of ethyl behaves with neutral sulphite of soda in a similar manner as ethylen chloride. Pure chloruretted chloride of ethyl, the boiling point of which was ascertained to remain constantly 63° C., was so mixed with sulphite of soda as to agree with two atoms of the latter substance against one of the former; the mixture was heated in a sealed tube for twenty-four hours consecutively at a temperature of 140° C. On opening the tube it was found that all the oily fluid had disappeared. The saline mass was first treated with dilute sulphuric acid until chlorine could not be any more detected by means of nitrate of silver, next neutralised with carbonate of soda, and, after having been evaporated to dryness, treated with alcohol; the therein soluble salt proved, on analysis, to have the exact composition of chlorethyl-sulphate of soda.

On the Synthesis of Hydrocinnamic Acid.—The formation of hydrocinnamic acid from cinnamic acid, and the fact first observed by Erlenmeyer, that the first-named acid is converted into benzoic acid on becoming oxidised, authorise the opinion that the constitutional formula of hydrocinnamic acid is—

$$C_6H_6+CH_2—CH_2—COHO.$$

M. R. Fittig has found this to be a correct view, by discovering a new synthetical method of preparation of the hydrocinnamic acid from phenylethylchloride, a colourless liquid which boils at about 200° C. This substance was first converted into a cyanide, by means of treating the same with cyanide of potassium and alcohol; this cyanide was decomposed with caustic potassa, the residue first acidified *with sulphuric acid*, next shaken up with ether. On removing the ether by distillation a yellow coloured acid fluid was left, which, on being repeatedly treated with cold water, became solid; a calcium salt of this acid was made, and found to be readily soluble in hot water, from which solution it crystallised in colourless silky-looking needle-shaped crystals. On being submitted to elementary organic analysis, this calcium salt, after having been first thoroughly dried over sulphuric acid, was found to yield results corresponding to the formula—

$$(C_9H_9O_2)_2Ca+1\tfrac{1}{2}H_2O,$$

which is identical with the formula derived by M. Erlenmeyer, from his researches on hydrocinnamic acid obtained from cinnamic acid.

On the Identity of Dichlorbenzoic and Paradichlorbenzoic Acid.—Dichlorbenzoic acid is readily prepared by boiling benzoic acid with a solution of hypochlorite of lime; the crude dichlorbenzoic acid obtained is combined with baryta, and the resulting salt purified by repeated crystallisation. The acid crystallises from its aqueous solution in needle-shaped crystals, fuses at 201° C., and sublimes without decomposition. The barium salt—

$$Ba(C_7H_3Cl_2O_2)_2+4H_2O,$$

crystallises in small needle-like crystals; the calcium salt—

$$Ca(C_7H_3Cl_2O_2)_2+3H_2O,$$

also appears to crystallise, and is more readily soluble in water than the baryta salt. From what has been communicated, it is clear that dichlorbenzoic and paradichlorbenzoic acid are one and the same substance.

On the Preparation of Methyl-naphthalin.—Methyl-naphthalin is prepared, according to Stacewicz, by heating together a mixture of a sulpho-salt of naphthalin, acetate of lime, and quick-lime. The distillate is dissolved in alcohol, and to the concentrated solution thus obtained water is gradually added; the substance thus separated is again dissolved in alcohol. After the evaporation of that menstruum a crystalline solid is obtained, somewhat yellow coloured, smelling like turpentine; it is sparingly soluble in alcohol, more readily in ether; is soluble in strong sulphuric acid, yielding to it a pink colour. Its specific gravity is about 1·0; it melts at 69° C.; formula, $C_{11}H_{10}$; percentage composition, C, 93·0; H, 7·0.

On Perchloride of Benzol and its Formation from Toluol and Xylol.—MM. Beilstein and Kuhlberg have instituted a series of researches in order to prove that heptachlortoluol is nothing else than perchloride of benzol. The former substance has its formula C_7HCl_7, and its composition in 100 parts is expressed by—C, 25·2; Cl, 74·5; H, 0·3. The latter substance is expressed by the formula C_6Cl_6, and in 100 parts it contains—C, 25·3; Cl, 74·7. Elementary analysis could not decide anything in this instance, but the authors having followed Hugo Müller's method for the preparation of perchloride of benzol, and by diligently making a comparative study of the melting points, boiling points, and degrees of solubility, found that these properties so perfectly agreed that they feel confident both substances are identical.

On some new Compounds Derived from Mesitylen.—MM. Fittig and Hoogewerff have made a series of researches on this subject. Chlorine, it appears, acts most violently on mesitylen even when kept cold, so that the authors found great difficulty in managing the effects of this gas. They obtained monochlormesitylen, $C_6H_2Cl(CH_3)_3$, a colourless fluid as limpid as water, which boils, without undergoing decomposition, at between 204° and 206° C.; it is readily soluble in alcohol. Dichlormesitylen, $C_6HCl_2(CH_3)_3$, is a solid; it crystallises from alcohol, forming beautifully shining prisms, fuses at 59° C., boils without decomposition at 243°, is readily soluble in warm alcohol, and, in the cold, in ether and benzol. Trichlormesitylen, $C_6Cl_3(CH_3)_3$; this substance is also a solid, and obtained when mesitylen, kept very cold, is treated with an excess of chlorine gas; it crystallises from boiling alcohol, yielding long colourless

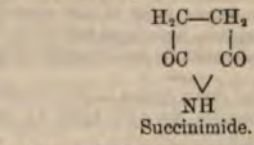
needle-shaped crystals, not very soluble in cold alcohol, better in ether; fusing, without decomposition, at 204°; sublimable, also, without decomposition, at a higher temperature. The authors have studied and extended their researches over a series of very complex compounds obtained by the action of nitric acid upon the monochlormesitylen, and also over the derivatives from sulphomesitylenate of potassium; but, for particulars about these compounds, we beg to refer our readers to the original paper, since the authors have so concisely exposed these researches, that it is quite impossible, in justice to them and the subject, to abstract these matters.

On the Specific Gravity of Chlorine.—M. E. Ludwig observes that, as a consequence of a series of determinations of the specific gravity of chlorine gas, the conclusion must be come to that this gas belongs to those kinds of vapours which only obey Mariott's law when it is at a temperature rather remote from that at which it is condensed to the fluid state. The specific gravity of chlorine at 20° C. is 2·4807; at 50° C., 2·4783; at 100°, 2·4685; at 150°, 2·4609; at 200°, 2·4502. According to experiments made by Stas, the specific gravity of chlorine, deduced from its atomic weight, is 2·45012. M. Ludwig has repeated experiments on this subject, and found the figures obtained and just quoted to be substantially correct.

On Allyl Alcohol.—M. B. Tollens writes to the editor as follows:—I find that allyl alcohol combines, although very slowly, with H_2, and no isopropyl alcohol is formed. When allyl alcohol is left for a considerable time in contact with a large excess of either sodium amalgam or zinc and dilute hydrochloric acid, some normal propyl alcohol is formed. When chlorine is made to act upon an aqueous solution of allyl alcohol, among other products I obtain a fluid boiling between 180° to 184°, and having its composition expressed by the formula $C_3H_6Cl_2O$; when this fluid is again treated with sodium amalgam, an alcohol is obtained. When this chloride, which happens to have the same composition as dichlorhydrin, is submitted to fractional distillation, I obtained one fluid which had its permanent boiling point at between 171° and 185° C.; the greater portion of the liquid distilled over at between 173° and 177°, a portion, however, also, at between 180° and 185° C.; the latter portion appears to contain the product derived from the action of chlorine upon allyl alcohol. Genuine dichlorhydrin boils at between 174° and 176° C.

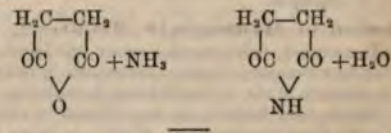
On the Products of the Destructive Distillation of Glycolic and Lactic Acids.—M. A. Krupsky records some experiments made by him on the products which glycollic acid yields when submitted to destructive distillation. 35 grms. of this acid were gradually heated, first to 120°, next to 160°, and at last to from 200° to 220° C., the retort being placed for several days in a metallic bath made of an alloy of 2 and 1-16th parts of lead and 3½ parts of tin, which alloy melts at 175° C. In the neck of the retort a solid substance sublimed, which could only be removed by breaking the neck of the same; on being removed, the substance was triturated in a mortar, first washed with alcohol, next with water. After repeated purifying, it was submitted to elementary analysis, and the result was—Carbon, 39·34; hydrogen, 6·69; the substance, therefore, is dioxymethylen. When lactic acid is exposed to a higher temperature, even below 200°, M. Krupsky found it to yield lactide; the most suitable temperature for the formation of this substance is between 210° to 215° C. Lactide is a solid, and exhibits beautifully rhombic crystals when its alcoholic solution is left to spontaneous evaporation. The author's advice to those who might desire to make this substance from lactic acid, is to take 100 grms. of the acid, to place it in a glass retort, heat first for eight or ten hours in a glycerine bath at from 100° to 110° C.; next the temperature is for thirty hours kept at from 135° to 140° C.; again the temperature is raised to 170°, and at last kept at from 210° to 215° C. for about forty hours; by this method, about 20 per cent of lactide is obtained from the quantity of lactic acid originally placed in the retort.

On the Melting Point and Relative Constitution of Succinimide.—M. Erlenmeyer observes, that when he made experiments on succinic acid and succinimide, the composition of which latter substance agreed entirely with the results obtained by Fehling, he was astonished to find that the melting of succinimide was not 210° C., as stated by some authors, but 125°. M. Teuchert having, in his essay on succinamic acid, repeated the statement about the melting point of succinimide at 210° C., M. Erlenmeyer has thought it his duty to review his work and repeat his former experiments, and, moreover, obtained from M. Fehling a quantity of pure succinimide; the melting point was again found to be 125° C. As to the constitution of this substance, I prefer to express it, says the author, by a formula written in the following manner:—



Succinimide.

Its origin from anhydrous succinic acid and ammonia is thus expressed:—



Neues Jahrbuch für Pharmacie redigirt, von Dr. Vorwerk, No. 3, 1869.

The present number of this periodical contains the following original papers:—

"*Soluble Saccharate of Oxide of Iron as Antidote against Arsenical Poisoning*," by Dr. H. Köhler. This is a paper containing the description of a series of experiments made upon living animals.—"*Characteristics of the Akazga Plant, and the Structure of its Wood, as compared with that of the Strichnos nux vomica*," Dr. R. Fraser. A botanical essay.

The remainder of the pages of this number of the periodical are filled with short abstracts taken from various periodicals published in England, France, and Germany; the greater portion interesting to our readers has been already published in these pages, we therefore confine our communication to the following:—

Analysis of Crude Cream of Tartar, Argol.—One gramme of this substance, taken from a thoroughly well mixed large average sample, previously powdered, is weighed into a tared porcelain crucible; the crucible and contents are heated to redness, and kept ignited until the contents are quietly in igneous fusion; let the weight of the residue found after cooling be called p. The crucible and contents are next boiled in distilled water, the fluid separated by decantation from the sediment is set aside, and the sediment washed until the wash-water no longer turns red litmus blue; the insoluble residue is dried at first on a water and next on a sand-bath. After its weight has been ascertained, it should be called r; $p - r$ is equal to the soluble portion of the ash which represents the carbonate of potassa. When the result of $p - r$, expressed in grammes, is multiplied by 271, the percentage of pure bitartrate of potassa is obtained contained in the sample of crude argol submitted to experiment; when the result of $p - r$ is multipled by 216, the percentage of crystallised tartaric acid is obtained.

Instability of the Solutions of Alkaloids.—A solution of 1 grm. of sulphate of quinine, 50 centigrms. of tartaric acid, and 20 grms. of water, was tested, after having been standing in a stoppered bottle for twenty months. It

contained 1·05 grms. of the saline constituents, instead of 1·40 grms., as when first prepared; it lost, therefore, 25 per cent. It appears, from communications received from various parties on this subject, that the same is observed to take place with most other alkaloids applied in pharmacy, and such solutions should not, therefore, be prepared for use in too large a quantity at the time.

Method of taking away the Bitter Taste of Epsom Salts.—When, in a solution of 30 grms. of this salt in 300 grms. of water, 10 grms of roasted and ground coffee is boiled, and the fluid filtered, the bitter taste of the salt is entirely taken away, and the fluid pleasant to take.

Bulletin de l'Académie Imperiale des Sciences de St. Petersbourg, T. xiii., No. 4.

This paper does not contain any communications which are of any value for our purpose; most of the communications do not refer to exact sciences, and those which do, bear upon physiology, comparative anatomy, and crystallography.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 136, April 15, 1869.

The following are original papers :—

"*Velocity of the Psychical Functions of the Brain*," by Prof. F. C. Donders.

Adhesion of Hydrogen to Metals.—M. A. De la Rive.—The author, referring to a paper published by him in 1843, has now repeated some experiments, in order to prove that the pressure of air, by facilitating the adhesion of hydrogen to metals, may become an impediment to the continuation of some chemical reactions, which, on being first called into play, are not affected by this cause.

As regards the remaining papers in this periodical, as far as they belong to chemistry, we have already published their contents; the said papers not being original communications, but abstracts from works and periodicals published in various countries.

Zeitschrift für Chemie, von Beilstein and others.

The seventh number of this periodical for the present year contains the following original papers, some of which are very lengthy, and can, therefore, be only briefly noticed:—

Synthesis of Hydroparacoumaric Acid.—MM. Glaser and Buchanan.—They have essayed to substitute, for a hydrogen atom in the benzol nucleus of phenylpropionic acid, hydroxyl, in the radical C_6H_5 of the acid just alluded to; this they have done by first preparing the amido acid of the nitrophenyl-propionic acid, next converting that amido acid into the diazo combination, and, lastly, by decomposing that compound, by boiling it with water. They thus obtained paraoxyphenyl-propionic acid, which, on being tested, proved to be identical with hydroparacoumaric acid. In the course of their researches, the authors have met with a great many new compounds, among which the nitrophenyl-propionic acid—

$$C_6H_4\begin{cases}NO_2\\C_3H_5O_2.\end{cases}$$

This is a solid substance, crystallises, exhibiting pale yellow crystals, difficultly soluble in cold, more readily in warm water, and very easily in alcohol and ether, and fuses at 153° C.; this acid forms readily soluble salts, which, however, crystallise difficultly. Hydrocabostyrol is also a solid substance; its formula is C_9H_9NO, fuses at 160° C., and can be distilled over at a higher temperature without decomposition. Amidophenyl-propionic acid—

$$C_6H_4\begin{cases}NH_2\\C_3H_5O_2.\end{cases}$$

Again a solid substance, crystallising, and then exhibiting *beautifully quadrilateral prisms fusing* at 131° C.; this substance forms, with acids, divers crystalline compounds. The other compounds we only briefly name, are the chloride of the diazophenyl-propionic acid, the oxyphenyl-propionic acid, and the parabromophenyl-propionic acid.

Action of Hydrobromic and Hydrochloric Acids upon Nitrobenzol.—H. Baumhauer.—Two and a half parts, by bulk, of a freshly-made aqueous solution of hydrobromic acid were mixed with one part, by bulk, of nitrobenzol, placed in a glass tube, and this, after having been sealed, was exposed to a temperature of from 185° to 190°. In this manner two substances were obtained—to wit, dibromaniline, which was in solution in the state of hydrobromate, and tribromaniline, which was left as an insoluble solid. When the experiment was repeated with hydrochloric acid, a crystalline substance was obtained, which the author has not further investigated.

Some of the Decompositions of Bromonitrous Acid.—M. L. de Koninck prepared this acid by means of saturating bromine cooled down to —10° with deutoxide of nitrogen; when an alcoholic solution of this compound is added to an alcoholic aniline solution, among other products, diazoamidobenzol is formed; when the aforesaid alcoholic solution was made to act upon nitrate of aniline, the author obtained a corresponding diazo compound. From this, and a series of similar experiments, the general result arrived at is that bromonitrous acid acts upon aniline as anhydrous nitric acid does upon that substance.

New Method of Preparing Cymol from Camphor, and on a Hydroxyl Derivate of Cymol.—Dr. R. Pott, while experimenting with camphor ($C_{10}H_{16}O$), tried to displace its oxygen by sulphur; and with that view he made sulphide of phosphorus, P_2S_5, act upon the substance; but, instead of succeeding with his intended substitution, he obtained cymol, since the sulphide of phosphorus acts by withdrawing water from the camphor, while, as by-product, a small quantity of a resin is formed at the same time. The best proportions for obtaining cymol by this method are five atoms of camphor to one atom of P_2S_5; the product obtained is purified by means of concentrated solution of caustic potassa and rectification over sodium. The hydroxyl derivative is obtained by fusing cymol with an excess of a mixture of potassa and sulphite of potassa, whereby a substance is formed, the formula of which, after having been properly purified previous to analysis, is $C_{10}H_{14}O$, a substance, therefore, to which the name thymol applies.

Hydroxyl Urea.—Drs. Dresler and Stein find that this substance originates when cyanate of hydroxylamine is formed from cyanate of potassa and a salt of hydroxylamine; the preparation of the hydroxyl urea, $N_2CH_4O_2$, is very complex, and, in consequence of the manifold operations required, too lengthy for description here. The resulting substance just alluded to is a solid, readily soluble in water, crystallises from alcoholic solutions in needle-shaped crystals, and fuses at between 128° and 130° C.; but if it be kept at this temperature for some time, it is decomposed, carbonate of ammonia is given off, and ordinary urea left. It is probable that the hydroxyl urea is, however, during this process of decomposition, first split up into cyanic acid and hydroxylamine. Solution of caustic potassa and strong nitric acid immediately decompose the hydroxyl urea. The author describes, also, a substance which he calls hydroxylbiuret, the formula of which is $N_3C_2H_5O_3$; it is a solid, soluble in water and alcohol, fusible at 134° C., but very readily decomposed, if kept, even for a few minutes, at this temperature.

Combination of Phosphoric Acid and Urea.—MM. Schmeltzer and Birnbaum have repeated some of Lehmann's experiments on this subject; they dissolved urea in a concentrated solution of ordinary phosphoric acid, and evaporated the fluid, without being warmed at all, over sulphuric acid in vacuo. In this manner a crystalline mass is obtained, which may be purified by re-crystallisation, after having been dissolved in distilled water and cautiously evaporated on a water-bath; the crystals thus formed belong to the rhombic

system, are readily soluble in water and alcohol, difficultly so in ether. The substance becomes decomposed when it is heated above 100°, giving off ammonia and carbonate of ammonia, and leaving metaphosphoric acid; the formula of this substance is CH_4N_2O,H_2PO_4. The authors state that other similar compounds have been obtained by them, and among these one containing 39 per cent P_2O_5, but this substance does not assume a crystalline shape.

Under the title of "Results of Researches made in the Chemical Laboratory of Professor Engelhardt, at St. Petersburgh," a paper follows, which is divided into three sections, each having a separate title:—1. "*Nitrotoluol and Amidotoluolsulpho Acids*," by M. Bek. 2. "*Isomeric Toluidine Sulpho Acids*," by J. Malyscheff. 3. "*Isomeric Naphthol and Benzoylnaphthol*," by Maikopar. However interesting these researches may be, the papers are too concisely written to admit of useful abstraction; and, from a foot-note placed at the end of these essays, we learn that researches on the same subjects have been made simultaneously elsewhere, and published, previous to the authors of the researches here referred to having had time to get their work printed and published in German.

The remaining few pages of this number of the periodical are filled with short paragraphs taken from the CHEMICAL NEWS, *Comptes Rendus*, and other periodicals, the subject matter of all of which has been noticed and published in our pages.

Les Mondes, Revue Hebdomadaire des Sciences, May 13, 1869.

We briefly notice, from the contents of this weekly paper, which are extremely varied, a proposal by M. Guignet—

To Preserve Butcher's Meat in Hot Weather, by placing it in large earthenware pans, putting clean heavy stones on it, and covering it with skim milk; the milk will become sour, of course, but may afterward serve as food for pigs, and the meat will be found to have kept its natural primitive freshness, even after eight or ten days.

Bronze.—It appears that at Berlin experiments have been made to determine under what circumstances the metallic alloy known as statuary bronze becomes most readily covered with what is technically called *antique patina*. As the result from a series of experiments, it appears that when genuine bronze is kept well cleansed, by washing the objects made of it with water, and next varnishing with oil, and rubbing the latter off with a piece of woollen stuff, and repeating this process once a month, it will produce the desired coating of patina very rapidly. Few of our readers acquainted with London are aware, perhaps, that the lamp-posts on London Bridge are, not as they seem, cast-iron, but genuine bronze, which of course, owing to the atmosphere it is exposed to, has become black.

Among the papers on geognosy, we meet with an interesting account of amber, too long for abstraction. This latter observation also applies to a paper of M. Dufour, on "*An improved Method of Examining the Flame of Burning Bodies and the Structure thereof.*"

The remainder of the papers relate to pure mathematics, and a long account of the meeting of the French Academy of Sciences.

Bulletin de la Société d'Encouragement, No. 195, March, 1869.

All the original papers of this number bear upon matters of engineering and mechanical science. The industrial notices contained in this publication, taken, as they are, chiefly from German papers, are rather antiquated; we only briefly notice—

Good Wholesome Bread.—Professor Stohmann advises to mix to ⅔ parts of rye meal, ⅓ part of bean, or pea meal, and 2 per cent, by weight, of the mixture, of ordinary common salt. It appears that bread thus made is of excellent quality, taking its constituents into consideration, and easily digestible.

Copal Varnish, according to Professor Böttger's prescription, should be made by first dissolving one part, by weight, of camphor, in twelve parts of ether; when the camphor is dissolved, four parts of the best copal resin, previously reduced to an impalpable powder, are added to the ethereal camphor solution, placed in a well-stoppered bottle. As soon as the copal appears to be partly dissolved, and has become swollen, four parts of strong alcohol, or methylated spirits, and ¼ part of oil of turpentine is added, and, after shaking the mixture, and letting it stand for a few hours longer, a thoroughly good copal varnish is obtained.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 6, 1869.

At the meeting of the Society held on the 22nd of March, under the presidency of Professor A. W. Hofmann, the following papers were read:—

Peculiarly Modified Physical Structure of Banca Tin.—M. J. Fritsche states, that during the intense cold of the winter weather at St. Petersburg in the month of December, 1867, and the first three months of the following year, a large quantity of blocks of Banca tin, warehoused in that city, had been entirely changed in physical properties; the metal was swollen up, and the inside of the blocks, which had become simultaneously very brittle, so as to break very easily, had been entirely honeycombed. M. Fritsche instituted some experiments, by submitting tin of the same kind, not previously affected by the winter cold, to the action of an artificial freezing mixture made of solidified carbonic acid and anhydrous ether, without obtaining anything like the results produced by the long-continued intensely cold winter. No chemical change had been produced; as usual, this kind of tin was of great purity.

Some Derivatives of Naphthol and Naphthobioxyl.—MM. Darmstädter and Wichelhaus.—The authors say that they have met with considerable difficulty to obtain nitro-derivatives of naphthol by directly acting with nitric acid upon that substance; when, however, a solution of naphthol-sulphuric acid is placed in contact with nitric acid, a red colouration ensues, and a solid yellow-coloured substance is precipitated; this substance is the binitronaphthol, which crystallises from its solution in chloroform, and fuses at 138° C. Naphtho-bioxyl, obtained by fusing naphthalin-bisulphuric acid (naphthalin-bisulfosaure) with caustic potassa, is a solid substance which crystallises in colourless needle-shaped crystals, soluble in alcohol, ether, and chloroform, difficultly soluble in water; formula, $C_{10}H_6(OH)_2$.

Changes which Orthoformic Ether Undergoes.—M. H. Wichelhaus.—Orthoformic ether, $CH(OC_2H_5)_3$, when heated in sealed tubes with liquid ammonia, did not yield the product the author sought for; but, on repeating the experiment with aniline and the same ether, a solid substance was obtained, which, on being submitted to elementary analysis, yielded results leading to the formula $C_{13}H_{12}N_2$, thereby proving, in connection, also, with the chemical and physical properties of the substance, that it is identical with the body Dr. A. W. Hofmann obtained from chloroform and aniline.

"*Substances Isomeric with Hydrosulphocyanic Ether which agree with the Essential Oil of Mustard*," by Dr. A. W. Hofmann. This lengthy and very concisely written, and evidently condensed, paper, is too long for abstraction, with due justice to the merits of the researches described and to the eminent author.

The papers which follow, and the correspondence, have been noticed in our pages already.

Annales du Génie Civil, April, 1869.

As may be expected from the title, this periodical only occasionally contains papers, or communications, relating to chemistry. We notice in this number:—

Bachet's Process for the Manufacture of Caustic Soda.—When litharge, chloride of sodium, and water are mixed together, oxychloride of lead is formed, and soda set free, according to the following equation:—

$$4PbO+NaCl+HO=(PbCl+3PbO)+NaOHO.$$

The oxychloride of lead thus produced being treated with milk of lime, chloride of calcium is formed, and oxide of lead reproduced according to this equation:—

$$(PbCl+3PbO)+CaO=CaCl+4PbO.$$

The operation, therefore, consists in making oxide of lead act upon common salt, exhausting the soda thus formed by washing out with water and evaporating the alkaline fluid. The oxychloride of lead being insoluble, is placed in suitable apparatus, and mixed therein with lime-water, whereby the oxychloride is re-converted into protoxide of lead. The chloride of calcium obtained as by-product is, however, at present almost entirely valueless.

New Manure.—We learn from the same paper that a double salt of sulphate of ammonia and sulphate of manganese, found in the mother liquors remaining from the boracic acid manufacture at the *lagoni* of Tuscany, a salt hitherto useless, though containing from 7 to 8 per cent of ammonia, and about 10 per cent of protoxide of manganese, is now applied as manure, instead of crude sulphate of ammonia, and gives excellent results; as attested, also, by the well-known Prof. George Ville.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 17, 1869 (No. 20).

Omitting matters of purely mathematical, astronomical, and mechanical interest, we notice the following memoirs:—

Expansion, by Heat, of some Metallic and Non-Metallic Simple Bodies, and some Compounds of Hydrogen and Carbon.—M. Fizeau has experimented upon some forty substances, nearly one-half of which number has been for the first time submitted to a rigorously exact method of determining the co-efficient of expansion by heat between 10° and 80° C., and with masses varying from 2 to 16 m.m. The co-efficient of linear expansion of diamond is equal to 0·00000118; that of graphite, 0·00000786; that of pure cast platinum, 0·00000899; that of cast gold, 0·00001443; that of cast silver, 0·00001921; that of copper, native from Lake Superior, 0·00001691. These figures we quote only as instances of the amount of labour bestowed by the author on a subject requiring great nicety of manipulation.

On the Kaolin of La Lizolle and Echassieres, Departement of Allier, and Existence of Tin Ore at the same spot, which has been worked in remote Antiquity.—M. Daubrée.—Although this memoir is certainly of local interest only in its geological, mineralogical, and commercial bearing, it deserves to be noticed, on account of the fact that the working of these kaolin beds, situated almost in the very centre of France, have been, at a very remote period of antiquity, the scene of mining operations, executed with the view of obtaining tin ore, from which, moreover, metal has also been wrought there, as evidenced by vestiges of furnaces found in the neighbourhood.

Some Properties of Chlorosulphide of Phosphorus.—M. Chevrier.—Chlorosulphide of phosphorus, $PSCl_3$, is a colourless liquid, possessed of a rather irritating, but not at all disagreeable odour; boils at 124·5° C.; (when barom. 750 m.m.) at 20° C., its specific gravity is 1·636; its vapour is difficultly combustible, and forms, when mixed with oxygen, a slightly explosive mixture. This substance is not decomposed by a strong electric current, or a series of electric sparks. When the vapour of this substance is made to pass through a red-hot porcelain tube, filled with pieces of broken porcelain, the vapour is partly decomposed, sulphur is deposited, and a mixture of chlorosulphide and *proto*chloride of phosphorus distils over. Water has the effect of slowly decomposing the chlorosulphide of phosphorus, thereby converting it into phosphoric, hydrochloric, and hydrosulphuric acids. This substance is also decomposed by chlorine; iodine and sulphur are readily soluble in this liquid, which is not acted upon by metals at the ordinary temperature of the air. Space forbids us here to enter into more particulars on the chlorosulphide of phosphorus, which has been exhaustively studied by the author.

"*Physical Constitution of the Sun; on the Results obtained by Spectrum Analysis, and by the Study of the Rotation of that Heavenly Body.*"—M. Faye, though an enthusiastic admirer of the results obtained by spectrum analysis, considers that the study of the mechanical effects of the rotation of the sun in producing certain phenomena on its surface, and in its photosphere, should not be neglected.—"*Influence of Temperature, as Affecting the Deviation of Gases from Obeying Mariotti's Law*," by M. Amazat. This is a condensed abstract from a larger paper, and too abstruse for further condensation.

Researches on the Phosphoric Acid present in that portion of Arable Soils which is Insoluble in Aqua Regia.—M. de Gasparin.—The labours of this gentleman reveal the fact, that even where there is the least appearance of the presence of phosphoric acid, it is met with in a quantity, which, if calculated for a surface of 1 hectare (2,471 acres), proves it to be relatively pretty abundant, though it be in a rather insoluble form. As instances, we take granitic sand from near Annonay (Ardèche), which in this way contains 0·62 per cent of its weight of this acid, amounting to 24.000 kilos. to the hectare. The siliceous diluvial sand of the borders of the Mediterranean contains 0·49 per cent, or nearly 20,000 kilos. to the hectare.

Solubility of Sulphur in the Coal-Tar Oils.—M. E. Pelouze.—Coal-tar oil, of 0·885 sp. gr., and distilling over at between 146° and 200° C., dissolves, at 15°, 2·3 grms. of sulphur; at 40°, 5·6 grms.; at 65°, 10·6 grms.; at 100°, 25·0 grms.; at 110°, 30·3 grms.; at 130°, 43·2 grms. As soon as the temperature decreases, the sulphur is precipitated in crystalline state, so that when the temperature was 130°, and the quantity of sulphur dissolved 43·2 grms., on cooling down to 15° only 2·3 grms. remain dissolved, and 40·9 grms. are precipitated. This property of the heavier coal-tar oils is made use of at the Paris gas-works to extract, from the materials which have been used in purifying gas according to Laming's process, the sulphur therein contained. The author of this paper reports very favourably on this plan, as greatly superior and less dangerous than the use of sulphide of carbon for that purpose.

This number also contains several papers relating to meteorology, and among these a very circumstantial account of the death, by lightning, of Captain Lacroix, of the Imperial Engineers, who was killed on the 7th of May last, while in his tent at the camp of Châlons-sur-Marne.

The American Journal of Science and Arts, March, 1869, No. 140.

This well-known and deservedly valued periodical contains, in its present number, the following original papers:—

"*Some Phenomena of Binocular Vision*," continued from a previous number, by Prof. Joseph Le Conte.

New Salt, containing Tin, Cæsium, and Chlorine.—S. P. Sharples.—This almost insoluble salt was accidentally discovered, and after having been purified, was found, on analysis, to consist, in 100 parts, of—chlorine, 35·84; tin, 19·49; cæsium, 44·67. The new salt will not serve for a quantitative separation of cæsium, as it is slightly soluble even in strong hydrochloric acid. Alcohol does not seem to have any influence upon the precipitation. If stannic chloride is added to a neutral solution containing CsCl, no precipitate is formed; but, upon adding to the solution about its own volume of strong hydrochloric acid, the salt is at once thrown down.

"*Atomic Volume of Liquids*," by Frank Wigglesworth Clarke. This extremely interesting and very concisely written paper is too lengthy for abstraction, an observation which equally applies to Dr. Wolcott Gibbs's paper "*On the Wave Length of the Spectral Lines of the Elements.*"

"*Condition of our Knowledge of the Processes in Luminous Flames.*" by Eugène W. Hilgard.—This paper contains a review of what is at present precisely, and with absolute certainty, known on a subject which, as the author well remarks, has been too much taken for granted. His paper, full of quotations from the papers and published memoirs containing the results of experiments by himself and many other scientific men, is too abstruse for abstraction.

Notices of New Meteoric Irons in the United States.—Charles Upham Shepard.—Meteoric Iron from Auburn, Macon County, Alabama; specific gravity varied from 7·0 to 7·17, and gave 7·05 as the mean. The iron is free from chlorine, dissolves in hydrochloric acid without giving off sulphuretted hydrogen, and leaves behind a slight residue of thin, brilliant, blackish scales and needles. Its percentage composition, by analysing 2 grms. weight, was found to be:—Iron, 94·580; nickel, 3·015; phosphorus, 0·129; insoluble, 0·523; chromium, magnesium, calcium, silicon (?), and loss, 1·753; total, 100 000.—Meteoric Iron from South-Eastern Missouri. Specific gravity, 7·015—7·112; no chlorine. In 100 parts:—Iron, 92·096; nickel, 2·604; schreibersite, 5·000; chromium, cobalt, magnesium, and phosphorus, traces; a fine residue of $Fe_2O_3SiO_3$ and C. Neither copper nor tin was found.—Meteoric Iron from Losttown, Cherokee Co., Georgia. In 100 parts:—Iron, 95·759; nickel, 3 660; insoluble, 0 580; chromium, cobalt, tin (?), and magnesium, traces.

"*Nitrification.*" by S. W. Johnson, is an essay on this subject, condensed from a lecture delivered before the National (American) Academy of Sciences.—"*Geological Notes on the Andes of Ecuador*," by James Horton.—"*Observations on Autumnal Foliage*," by Joseph Wharton, is a paper on chlorophyl and some observations and experiments made on this substance by the author, to which he has appended short abstracts containing the records of the results of the experiments on chlorophyl by Prof. Frémy and others; the author's experiments have more a physiologico-botanical, than a chemical bearing.

Modified Form of the Nitrate of Silver Test for Arsenic Acid.—Charles E Every.—The author has thoroughly studied and experimented upon this subject. It is known that arseniate of silver is slightly soluble in an aqueous solution of nitrate of ammonium, and readily soluble in both ammonia and dilute nitric acid; it is not easy to detect small quantities of arsenic by means of nitrate of silver, as usually employed, unless the test be applied with extreme care. The author found that the addition either of acetate of sodium, acetate of ammonium, or Rochelle salt, to a mixed solution of arsenic and nitric acids, is sufficient to ensure the immediate precipitation of arseniate of silver when ammonio-nitrate of silver is introduced. Instead of the acetates or tartrates, recently precipitated carbonate of silver may be employed to neutralise free nitric acid. When present in relatively large quantity, arsenic acid readily precipitates silver from a solution of nitrate of ammonium and ammonio-nitrate of silver, but the colour is uncertain.

Next follow:—"*Notices of Papers in Physiological Chemistry*," by Dr. George F. Baker; a long essay continued from a former number of this periodical. The scientific intelligence which concludes this number is partly abstracted from articles of journals and periodicals published in Europe, and is partly of local interest only.

NOTICES OF BOOKS.

A History of Chemical Theory from the Age of Lavoisier to the Present Time. By Ad. Wurtz, Membre de l'Institut (Académie des Sciences). Translated and Edited by Henry Watts, B.A., F.R.S. London: Macmillan and Co., 1869. Pp. 220, 8vo.

Our readers will recognise under the above title the "Discours préliminaire" which constitutes a kind of preface to M. Wurtz's "Dictionnaire de Chimie" now publishing in France. A work in the English language, and specially devoted to chemical history, appears so seldom in this country, that we purpose commenting upon it at somewhat greater length than the intrinsic merits of the book might appear to demand.

M. Wurtz's *history* commences with a brief introduction, which is followed by four chapters in which attention is directed to the respective doctrines of Lavoisier, Dalton and Gay-Lussac, Berzelius, and Laurent and Gerhardt. Another chapter is devoted to the discussion of existing theories; and this is followed by a few explanatory notes, to which the editor has judiciously added.

The opening sentences of the introduction are not likely to meet with very general acceptance among the chemists who are acquainted, even but a little, with the development of existing doctrines. That "chemistry is a French science," and that "it was founded by Lavoisier," are two propositions which reduce the whole subject, not only to a nationality, but to an individual, and neither of these propositions has any historical foundation whatever. We also feel bound to deny—in language no less decided than that of M. Wurtz, who affirms that, for ages preceding Lavoisier, chemistry "had been nothing but a collection of obscure and often fallacious receipts"—that Lavoisier's system was more scientific than that of Stahl, and that Lavoisier was "the creator of the true method in chemistry." Claims of this character invariably carry a doubtful appearance, and even a general reader would hesitate to admit them. It is surprising that M. Wurtz, in his zealous and just endeavour to honour the memory of a truly great man, should estimate the labours and ideas of the ancients at so paltry a value; for, considering how little real novelty can be attributed with certainty to the French chemist, and how much he derived from his immediate and remote predecessors, Lavoisier himself is the only loser by the comparison. It must not be forgotten, however, that we are dealing with a traditional method. No sooner had Lavoisier formed in his own mind a clear conception of the plan he was about to pursue, and collected a few able associates around the regal standard, than he boldly named his system "French Chemistry." There was much art in that designation. In the first place he made interest with the vanity of his nation; in the second, he ignored antiquity; and, lastly, he thereby ensured the perpetuation of his personal fame. This title, however,—the sagacity of which we cannot but admire,—was accompanied by a great deal of practical arrogance. Chemistry in France, instead of following its own natural development, was dispensed by a despot and his courtiers. In Germany the schools were insulted by the information that Stahl, their common and respected master, was destitute of common sense, and his theory of phlogiston a delusion; so that we cannot much wonder at the slowness with which the new system crossed the Rhine. In England it soon found powerful (and, perhaps, too partial) advocates, though even some of these were offended at Lavoisier's dictatorial manner and disingenuousness.

It has always been admitted, and we think with much correctness, that Lavoisier's achievements are all connected very intimately with the study of oxygen. No one could have better pointed out the logical value of his deductions, or the admirable sequence of his reasoning, than M. Wurtz has done in this volume. But we owe the discovery of oxygen to Priestley and Scheele; that it constitutes a part of the air, and is the one important agent both in combustion and calcination, were facts known to Hooke [whose name is omitted from this chapter]. The increase in weight of metals when calcined had been acknowledged, we need hardly say, long before Lavoisier. Cavendish and Watt were the first to ascertain the composition of water. Black published the doctrine of latent heat (whic

here). These are the essential, indeed the only, bases of Lavoisier's system. What, then, becomes of the statement that "chemistry is a French science?" Surely Davy was well warranted in saying "his discoveries were few, but he reasoned with extraordinary correctness upon the labours of others." Lavoisier's merit rests in the circumstance that he combined the scattered links which we have mentioned into a firm and single chain; not in the deceptive supposition that he inaugurated a new era. As an innovator he failed entirely. Few conceptions could be more gross or retrograde than that of oxygen as the acidifying principle, or (as he at one time conjectured) than that of nitrogen as the alkalizing principle. It is clear, in fact, that the general acceptance of Lavoisier's system by his contemporaries depended on the very circumstance that it was, in its separate details, essentially old and not new.

We must not omit to notice the stress that many writers have laid upon the quantitative character of Lavoisier's experiments, involving, as it is commonly believed, the first introduction of the balance into chemistry. This fallacy is very well exposed by Mr. Watts, who, in a note at the end of the volume, gives a detailed account of Black's famous research on the nature of mild and caustic alkalies. Professor Wurtz, who is silent on this point, certainly mentions the memorable analyses of Wenzel, and the philosophic intention with which they were undertaken; but why the German chemist should be said to have "toiled in the dark" (*travaillait obscurément*) does not altogether appear, unless we are to allow that the brilliant Frenchman involved his contemporary in a total eclipse. Strictly speaking, the idea of weight does not possess so great a value as is commonly assigned to it, and a science of chemistry might very well exist without that idea as a factor. The broader and necessary conception of *number* was, in reality, and in this respect, what Lavoisier so eminently aided in announcing. That the notion of the indestructibility of matter even presented itself to his mind as a clear inference is very improbable, or, at least, an open question.

The study of the functions of oxygen had naturally led Lavoisier back to dualism; that is to say, he had re-established, but on a wider experimental basis, the fundamental conception which we owe to the iatro-chemists. Thoroughly conscious of the true value of language, he added to the maxims of Condillac the practical efforts of Morveau. Morveau was induced to abandon the phlogistic doctrine; a committee was appointed with Lavoisier at its head, and a nomenclature soon appeared from which the name of phlogiston was absent, and which embodied the spirit of the rising school. That nomenclature was undoubtedly a great success in its time, and its establishment was justified on principles to which few will deny either wisdom or foresight.

The idea of number soon assumed a very important phase in connection with chemistry. The law of multiple proportions, first observed by Higgins, and re-discovered by Dalton fifteen years subsequently, received, at the hands of the latter philosopher, an interpretation in accordance with the ancient notion of atoms. Higgins represented these atoms as held together by mutual forces symbolised by lines. Dalton employed in his lectures a wooden sphere with radiating spokes. The modern notion of atomicity (if any clear notion really exists on such a subject) has, therefore, a somewhat remoter parentage than is commonly assigned to it. The announcement and gradual acceptance of the atomic theory mark especially an influx of materialism which has already reached its highest point, and is now commencing to recede from the steady shore of philosophic thought. M. Wurtz speaks strongly in praise of Dalton, whose name, he says, "is one of the greatest in chemistry," and points out, also, in this chapter the well-known relation between Gay-Lussac's great discovery and that of his English contemporary. The parts taken respectively by Avogadro and Berthollet on the latter question are also very clearly and excellently stated, but, perhaps, a little too briefly.

Berzelius adopted the atomic theory, but did not contribute to it any modification of serious importance. His quantitative work, though, doubtless, suggested by that theory, is, in its results, quite independent of any theory. Like Lavoisier's, his system was essentially dualistic, but his dualism was in many points different from, and superior to, that of his French predecessor, and had the advantage of reposing on a purer dynamics. The "binary theory," as it has been termed, was hardly ripe for discussion when a warm controversy took place between Berzelius and the French school led by Dumas. But we must refer the reader to M. Wurtz's book for a detailed and lively account of the campaign. The disorder, confusion, and misapprehension of the real question at issue have certainly not been surpassed in scientific history. Berzelius originated our present symbolic system, and the nomenclature which he had introduced, revived as it has been by Williamson, is gaining favour in this country.

The next chapter is devoted to an account of the doctrines of Laurent and Gerhardt. How far these great men, whose names will be for ever united in one dualistic formula, ever really adopted the atomic theory, is somewhat difficult to ascertain, and was, perhaps, unknown to themselves. That they protested against any representation of atomic arrangement is certain; but they adopted atomic language on many occasions. The doctrine of types and the numerical criteria of formulæ largely occupied their attention, but the idea of Gerhardt's "series" was borrowed from Avogadro.

M. Wurtz's final chapter is devoted to a lengthy discussion of the theories which prevail at the present day; their immediate origin and interdependence are pointed out with great clearness and force. It is stated, and with much truth, that these theories are essentially atomic; and the author, who has himself largely contributed to their success, of course heartily supports them. We do not propose to criticise them in this place, for such a procedure would hardly fall within the province of a contemporary reviewer, but content ourselves with warning students to suspend their judgment upon any corpuscular doctrine until they are really able to decide upon it for themselves. The influences of atomicism are so subtle that, if once committed to their acceptance, it is almost impossible for any mind to effect an escape.

We cannot, in conclusion, refrain from expressing our thanks to M. Wurtz for an account of chemical history in which, though some serious errors occur, there is so much to gratify and attract. The style is so lively and energetic, the argument so deductive, and the meaning so unmistakable, that we cannot help feeling how great a contribution has been made towards satisfying a real want of our time; and we commend the work to our readers with all the more confidence, because the editing and translation have been so judiciously executed. The notes which Mr. Watts has added are, moreover, evidences of the importance which he is well known to attach to an impartial statement of facts, and will serve to remedy some of the faults we have alluded to. Chemical literature in England owes a fresh debt to Mr. Watts, and we sincerely hope that his edition of M. Wurtz's *discours préliminaire* will aid in reviving a taste for a neglected but most important branch of literature.

A Course of Six Lectures on the Chemical Changes of Carbon. By WILLIAM ODLING, M.B., F.R.S., Fullerian Professor of Chemistry, Royal Institution. Delivered before a Juvenile Auditory at the Royal Institution of Great Britain during the Christmas Holidays of 1868-69. London: Longmans, Green, and Co.

FEW men who have ever devoted themselves to chemistry, forget their first attendance at a chemical lecture. The lecturer may not be profoundly learned, or even a brilliant manipulator—he may use hard words, and omit to explain them; he may totally fail in some experiments, and only

partially succeed in others—it matters not; to an intelligent and imaginative boy there is a magical charm about the new world thus opened to his mind which time can never efface.

But replace the school-room by the theatre of the Royal Institution, the amateur or itinerant lecturer by Faraday, the imperfect apparatus by all the appliances which refined science can suggest; can we then wonder if the impressions so formed exercise a lasting and glorious influence over the mind of the youthful spectator?

Only those who have seen the rapt and delighted gaze of the juvenile audiences, as they followed, with intelligent appreciation, each experiment and explanation of Faraday, can fully appreciate the enormous amount of good which must arise from these lectures.

The worthy successor of Faraday, in his Chair at the Royal Institution, has so far followed in the footsteps of his predecessor, that he has continued to give lectures to the young, and with eminently successful results.

The present series of lectures on the chemical changes of carbon will be found to contain all that can be said upon the subject capable of being comprehended by a juvenile auditory; and being printed as they were taken down *verbatim* by the reporter of the Chemical News, they possess all the vivacity, as well as originality and clearness of style, which distinguish the eminent chemist by whom they were delivered.

A remarkable feature in these lectures is the fact that every term made use of is defined as it occurs, and the oral definition is supplemented by a clear and decisive experimental illustration.

It must not be forgotten that *Carbon*, in some respects, stands alone among the elements. Its compounds are more numerous than those of any other element, and their history by the older chemists was considered to constitute a distinct branch of the science, and called "Organic Chemistry." In the present day, the results of research have been to break down the barriers which were supposed to exist between organic and inorganic chemistry; and it has been found that a vast number of bodies, at one time supposed to be producible only by the agency of animal or vegetable life, can now be formed by the chemist from absolutely inorganic matter. The result of these discoveries has been that the phrase "Organic Chemistry" is, by the more advanced chemists, abandoned for the more accurate term, "Chemistry of the Compounds of Carbon."

While reminding our youthful readers that the chemistry of carbon includes the chemical history of all animal and vegetable substances, we cannot, we think, offer them better advice than to commence that grand study by a careful perusal of Dr. Odling's Lectures "On the Chemical Changes of Carbon."

Chemical Labels, according to the latest System of Nomenclature. London: H. K. Lewis. Price 1s.

A series of Chemical Labels, with Symbols, arranged according to the New Notation. Leeds: Harvey, Reynolds, and Co. Price 6d.

Complete Series of Photographic Labels, including Solids and Solutions, with Duplicates and Blank Labels. Leeds: Harvey, Reynolds, and Co. Price 6d.

Mawson and Swan's Book of Chemical Labels. Revised Edition. Newcastle-on-Tyne: Mawson and Swan. Price 1s.

Few things are more necessary for a chemist's laboratory than good, boldly printed labels, and, for the student of the present day, it is almost essential to use those in which the old and new formulæ are given.

The first of these series has been very carefully compiled by Mr. Henry Matthews and Mr. C. W. Quin, whose names alone are sufficient to guarantee an expenditure of time and thought in their arrangement, which cannot fail, in a great measure, to meet the requirements of the analytical chemist. The compilers have, we think, been judicious in selecting labels for those tests and reagents only which are in constant use.

Messrs. Harvey and Reynolds's series are arranged according to the new notation, and only the new formula is given; the type is clear and distinct, and the book is well worth the moderate sum charged for it.

Photographers will do well to avail themselves of the useful and complete set of labels for photographic chemicals, which appears to contain all the solids and solutions in present use. We would, however, suggest that, in a new edition, the word *poison* should be annexed to such substances as cyanide of potassium, &c.; for, although it is not customary for wholesale houses to take this precaution, it is highly necessary for it to be observed, where poisons are in constant use; and especially for cyanide, which is used in solution for fixing positives, by young amateurs and others, who are not always the most careful with poisons.

We are glad to find that the revised edition of Mawson and Swan's labels is free from the many imperfections of the first. The labels are alphabetically arranged, with the inner margins perforated. The names and formulæ accord with the latest editions of "Fownes," "Roscoe," and "Fresenius," while, in most instances, the old names and formulæ are given in italics. The term *acid* is restricted to hydrogen salts, and the specific gravities of the strong and dilute acids as well as the proportions of acid to water are given. Labels intended for solutions of salts bear the word "solution," and the various states of tests and reagents are appended, thus obviating the practice of using the same label for a salt, whether it contains water of crystallisation, or is in a state of fusion, or in solution. We can certainly say of this edition what we could not conscientiously say of the first, that it has been compiled with an amount of care and attention which could only be bestowed by a chemist well versed in both the old and new systems of nomenclature and notation, and fully maintains the high character the publishers have attained as manufacturers of chemical apparatus and pure chemicals.

CORRESPONDENCE.

Equivalence and Quantivalence.

To the Editor of the Chemical News.

Sir,—As an admirer of the logical and very appropriate moderation evinced by the President in the discussion at the last meeting of the Chemical Society, I would moot that Mr. Ward's attack is not altogether in good taste; his long letter of nearly three columns is a reiteration of the "Hofmann" text without a single emendation or improvement. He may write grandiloquently of the all-important and momentous law of quantivalence; but Chemistry is making progress, and since the work of Hofmann newer and profounder treatises have appeared with admissions that may well justify the humble and cautious attitude referred to.

It is not true that the doctrine of equivalents only leads to the question *How much?* for it equally embraces the *How many?* Nor is it at all denied the full benefit of volumetric guidance, with all other physical and chemical aid.

What more does the momentous law of quantivalence provide? Mr. Ward says that N is trivalent. Mr. Equivalent says that in relation to H it is trivalent or triatomic; but is it so essentially or *per se?* Mr. Ward says not! Is the trivalent or "equiquantic" nitrous acid the most definite or stable of its oxy-combinations? Mr. Ward says not! Is this momentous law in any way the expression of chemical force or "chemism?" Mr. Ward says not!

Is S''O'' equiquantic? Because, as that is the weakest of its principal forms of combination, peradventure quantivalence may be a law of weakness.—I am, &c.,

Chemicus.

On a Remarkable Passage in Priestley's "Letters to Canton."

To the Editor of the CHEMICAL NEWS.

SIR,—Being engaged in arranging the Canton Papers, which belong to the Royal Society, I have come to a letter of Dr. Priestley, addressed to his friend Mr. Canton, and dated "Leeds, 12th November, 1767." After describing some experiments on the melting of brass and steel wires by the electric shock, he concludes his letter in these terms:—

"You will think I talk strangely, but I own that these experiments, together with that of the insulated hot glass mentioned p. 716 of my book, and others too long to recite here, make me inclined to think there is no electric fluid at all, and that electrification is only some new modification of the matter of which any body consisted before that operation."

It is remarkable that Priestley here anticipates the theory which is now generally adopted by electricians. I cannot find, however, that he assumed it permanently, or decisively; on the contrary, he strongly inclined to Franklin's hypothesis of the positive and negative state of all electrified bodies. With a view to ascertain his opinion, I have examined the five editions of his "History of Electricity," and also his "Familiar Introduction to the Study of Electricity." He considers Franklin's theory to be "the most probable of any that have been hitherto proposed to the world" (Hist. of Electricity, part 3, § 2). After a full discussion, he speaks of it in the following terms:—

"Dr. Franklin, the author of this excellent theory of positive and negative electricity, with a truly philosophical greatness of mind to which few persons have ever attained, always mentions it with the utmost diffidence. 'Every appearance,' says he, 'which I have yet seen, in which glass and electricity are concerned, are, I think, explained with ease by this hypothesis. Yet, perhaps, it may not be a true one, and I shall be obliged to him who affords me a better.'"

At the time when Priestley and his friends were employed upon these researches, the celebrated Father Boscovich had attained to the summit of his fame. In the year 1760 he was elected a Fellow of the Royal Society, having visited London and enjoyed the intercourse of some of the most eminent philosophers of this country.* His theory of the constitution of matter, according to which it consists of centres of attraction and repulsion, had become generally known. Both Priestley and his friend and neighbour, Michell, had been interested in it.† We may infer that, in proportion as Priestley regarded with approbation "this sublime theory of the constitution of matter," he must have been inclined to regard electrical phenomena in the same light, which he has clearly propounded in the above-quoted passage.—I am, &c.,

JAMES YATES.

Lauderdale House, Highgate, N.,
May 8th, 1869.

Alkali Works.

To the Editor of the CHEMICAL NEWS.

SIR,—I beg leave to ask the opinion of your readers to the following questions.

(1.) Should not alkali works, when they are enrolled under an act of parliament, be exempt from proceedings at law, unless the prosecution is conducted by, and is the result of infringement detected by, the Government Inspector appointed for that purpose?

As a great many cases have, within the last year or two, been brought before the county courts by farmers, and, as the verdict, in the majority of them, has been against the manufacturers, notwithstanding that the Alkali Inspector has appeared as a witness on the opposite side to the farmers, and testified to the complete state of condensation at the time, the following other question suggests itself.

(2.) Should not a special scientific legal court be formed for the trial of these cases?

The legal gentlemen connected with county court business laughingly admit their ignorance of chemistry, and at least one judge is exultingly spoken of by farmers as being "dead against chemical manufacturers;" and my impression is that there should be a proper tribunal, and the Inspector, and he only, should be the prosecutor. In Mr. Stephenson, M.P., South Shields (a large manufacturer of chemicals), and Dr. Lyon Playfair, we have good representatives, and I trust they will keep a vigilant lookout.—I am, &c.,

"AN INTERESTED PERSON."

May, 1869.

Equivalence and Quantivalence.

To the Editor of the CHEMICAL NEWS.

SIR,—Mr. Ward, in a communication to the CHEMICAL NEWS of April 30th (*Am. Repr., June*, 1869, *page* 331), appears to misunderstand the point referred to by Dr. Williamson, since he evidently confounds the terms *equivalent* and *atomic weight*. Your readers will, doubtless, admit the justice of Dr. Williamson's remarks, when they see clearly put before them the theory of equivalence and that of atomicity, or, as Mr. Ward well calls it, of quantivalence.

Let us take the two chlorides of phosphorus, PCl_3 and PCl_5. The theory of equivalence asserts that, in the former, the equivalent weight of phosphorus is $\frac{31}{3}$, that of chlorine being 35·5; while that, in the latter, the equivalent weight of phosphorus is $\frac{31}{5}$; in a word, that the quantivalence of phosphorus is variable. Those who uphold the theory of quantivalence, assert that phosphorus is, under all conditions, trivalent. They maintain that, in compounds resembling phosphoric chloride, the two extra monad atoms (or what is equivalent to them) are combined with the phosphorous compound, in much the same way as that in which one salt combines with another salt to form a double salt. The quantivalence of phosphorus, according to this theory, is invariable.

It would be difficult to find two theories more antagonistic than these. It was, therefore, with great justice that Dr. Williamson complained that many chemists employ the terms equivalent and atomicity indiscriminately; seeing that the former implies a variable, the latter an invariable, quantity.

It is necessary to draw attention to the abuse of the word "fact" in Mr. Ward's letter. He does not distinguish clearly between a *fact*, and a *theory* founded upon facts. The equivalent weight of an element in any particular compound is a fact; its atomic weight and its quantivalence are theories founded upon facts. All chemists agree that, in marsh gas, the equivalent weight of carbon is 3, that of hydrogen being 1; but some ascribe to carbon the atomic weight 6, others 12; and hence we have the different molecular formulæ—

$$C_2H_4 \text{ and } C\,H_4,$$
$$(6) \qquad (12)$$

both representing marsh gas. In the same way, some assert that carbon is divalent; others that it is tetravalent. If the atomic weight and the quantivalence of carbon were facts, what ground would there be for any dispute?—I am, &c.,

TEMPLE A. ORME.

University College School, London,
May 8th, 1869.

A Plea for the Word Quantivalence.

To the Editor of the CHEMICAL NEWS.

SIR,—Most chemists seem disposed to accept the notion of atomicity, but apparently object to the word itself. The ideas conveyed by the terms monatomic (H', &c.), diatomic (O'', &c.), triatomic, (N''', &c.), tetratomic (C'''', &c.), more or less

* Fabroni, "Elogi," Tomo ii., p. 41; Rees's "Cyclop.," vol. v., article Boscovich.

† Priestley, "History of Discoveries relating to Vision." "Inquisitions relating to Matter and Spirit," vol. i., pp. 24-42.

modified, are generally agreed to, the names themselves rejected. The cause of this rejection is found, doubtless, in the fact that, instead of conveying to the mind the intended impression of the single, double, triple, and quadruple *value* of atoms in forming molecules, the words monatomic, diatomic, triatomic, and tetratomic give the erroneous impression of *number*; a diatomic body, for instance, is liable to be regarded as containing two atoms, whereas double value alone is intended. In place of these names those of univalent, bivalent, trivalent, quadrivalent, about which there can be no ambiguity, are being adopted by leading chemical authors; but as to which of the words *equivalence* and *quantivalence* shall displace *atomicity* there is difference of opinion. The appellations "equivalence" and "equivalent" are claimed as well known and as covering all the ground commanded by "quantivalence." This they do, undoubtedly, but the objection to them is that they do much more and, from their relative nature, possess any meaning required by the context. The word *equivalent* (with which *equivalence* is indissolubly connected) is not only frequently required and used, and rightly so, by chemical and other authors in several different general senses, but employed in reference to a chemical atom, it may properly be intended to have distinct meanings. Thus, in regard to the exchangeable values of atoms of chlorine, oxygen, nitrogen and carbon, their respective equivalents are commonly 1, 2, 3, 4, while in displacing 1 part by weight of hydrogen their equivalents will be 35½, 8, 4⅔, 3, and in forming molecules, 35½, 8, 14, 6, according to old notions, and 35½, 16, 14, 12, according to new ideas. To speak of atomicity (or the subjects of univalence, bivalence, trivalence, and quadrivalence), under the general term *equivalence* is to place unnatural restrictions on the latter word, and divorce the term *equivalent* from proper associations. On the other hand, *quantivalence* is open to none of these objections, and fully satisfies all requirements.

The philology of the matter is indisputable. Let us have either monatomic, diatomic, triatomic, and tetratomic, or univalent, bivalent, trivalent, and quadrivalent; not such hybrids as biatomic or divalent. Pupils of indifferent education also need sometimes to be reminded that the correct pronunciation of the quan-tiv'-a-lence terms is u-niv'-a-lent, biv'-a-lent, triv'-a-lent, quad-riv'-a-lent.—I am, &c.,

JOHN ATTFIELD.

17, Bloomsbury Square.

Equivalence and Quantivalence.

To the Editor of the CHEMICAL NEWS.

SIR,—I would suggest that the quantivalent discussion has not made good progress.

Mr. Orme unfairly insists that equivalent notions involve an "equivalent weight" of nitrogen in ammonia to be ¼, &c., &c.

Between the modern views of "atomicity," as cautiously put forth by Wurtz and other leading chemists, and the older views of "equivalents" there is, I moot, *no essential difference*. To both the N of ammonia is equally triatomic or trivalent.

But Mr. Attfield takes up an entirely new position, viz.—that quantivalence is an essential quality *per se*. If it could be shown that N is equally trivalent in nitrous oxide, nitric oxide, nitric acid, the peroxide, and also in nitric acid, and similarly for other multiple combinations, then the matter would be settled.

It is true that ammonia is a leading and characteristic type of combination between N and H, but it is not exclusively such.

The ratio is—

1 to 2 in amidogen.
1 to 3 in ammonia.
1 to 3½ (2 to 7) in atmonium?
1 to 4 in ammonium.

The atmonia ? type is not well recognised, but it is becoming very prolific in the innumerable amides, ureas, ureides, &c., &c.—I am, &c.,

CHEMICUS.

Alkali Works.

To the Editor of the CHEMICAL NEWS.

SIR,—In my letter on "Alkali Works," which you kindly published on the 14th inst. (*Am. Repr., July*, 1869, *page* 44), I did not explain my ideas very fully for fear of intruding too far upon your valuable space, but after your remarks in last week's CHEMICAL NEWS (and for which I heartily thank you), I request your indulgence while I make a few supplementary notes.

Alkali Works are now generally conducted by men with considerable scientific and practical knowledge, and much care and attention is applied in order to obtain in all cases the full produce, *i.e.*, as near the theoretical as possible, from all materials, whether solids or gases, and as this can be and is accomplished without any appreciable loss, I assumed and worked upon this assumption when I made my remarks, that no gas did or was liable to escape, except muriatic acid, and as this was under the supervision of an inspector appointed for the purpose, I considered that he was the one to prosecute if such was necessary.

To expect no odour whatever from a chemical works is too much, as it is, for instance, impossible to run still liquor off without a slight smell; but any constant escape of sulphuric or nitrous gas is quite unnecessary, and in such cases by all means let farmers and others have some means of getting redress for damage done. But, again, care must be taken that a system of *persecution* is not resorted to; and without a Court is formed for the trial of these cases, which can sift and understand the *scientific defence* of the defendants, such a state of things will result, as, for instance, I see before me a chemical works surrounded by a few other works, not alkali, but for all that emitting acid gases (glass, and other works). These are situated in an agricultural district, and consequently, the people about there are more sensitive at their nasal members. The alkali works may have got an hereditary bad name, but no gas is allowed to escape now, yet the representatives of agriculture in that neighbourhood would, in case they saw their crops injured by gases, at once complain of the alkali works and never suspect the glass works. The reason of this is, that the uninitiated, in passing the former works, no doubt will smell an odour, while, in passing the latter, they will not smell any, and they at once, in their ignorance, put down as a fact, that the alkali is the guilty work. They do not know that, if an alkali work is properly conducted, no gas, in such a quantity as to do harm to agriculture, is allowed to escape, and that the mere puff or smell they experience in passing is quite unavoidable (as coming off, say, still liquor when being run off), but, at the same time, quite harmless, although it does go direct and affect their smelling power. Again, in their ignorance, they are not aware that other works, such as glass, are allowed to evolve *streams* of gas from their chimneys, which, instead of making itself known to every passer-by, goes, or rather is blown quietly, but in an unremitting stream, on to the adjoining fields. If a case of this sort was brought before a county court, as at present constituted, the verdict would go against the alkali manufacturer, because the judge, not understanding the chemical defence, would take the same view of the case as the farmer. I beg to ask if this state of things is fair?

For my part, I do not by any means wish to deprive farmers and others from complaining, but, knowing as I do the care that is taken by some people to prevent, and how unnecessary it is to allow gases to escape, I only wish that justice may be done to those who, perfectly innocent, may yet be so unfortunate as to be blamed for gases allowed to escape from contiguous works, unsuspected, perhaps, simply because they are *not* alkali works.—I am, &c.,

AN INTERESTED PERSON.

Laboratory Pump.

To the Editor of the CHEMICAL NEWS.

SIR,—As you published some weeks ago an account of Professor Bunsen's valuable filter pump, I may take the opportunity of describing a simple form of this pump which has been fitted up in my laboratory by Mr. Stephen Yeates, of Dublin.

The accompanying diagram shows the essential parts of the pump. A is a tube of tin, about eight inches long, and of nearly one inch internal diameter; within three inches of one end the tube B is soldered. The diameter of this tube should be about ⅜ of an inch. The end of the wide tube most distant from B is now contracted so as to form a portion of a cone, and D then soldered in. A small tube, C, is now selected, one extremity of which enters, but must not at all close, the cone formed by the junction of A and D; and at this point its orifice is contracted, so as not to exceed ⅛ of a inch in diameter. It is then soldered, as shown, into the upper end of A. The whole arrangement is fitted to a board by the straps, s, s.

The tube, C, is connected with the vessel to be exhausted of air. B is the delivery pipe for water, obtained from a cistern or from the street main; the supply should admit of regulation by means of a stop-cock placed in the course of B. In order to obtain the maximum exhaustion with the pump, the length of D should be about thirty-three feet, but a fall of twenty feet I find to be more than sufficient for ordinary water. As this form of Bunsen's pump can be constructed by any intelligent plumber for a few shillings, no chemist need be deterred, either on account of expense or trouble, from fitting his laboratory with the new apparatus.

I have had the pump in operation in my laboratory for about two months, and gladly bear testimony to the great practical value of Professer Bunsen's admirable arrangement.—I am, &c.,

J. EMERSON REYNOLDS.

Laboratory, Royal Dublin Society,
Kildare Street, Dublin,
April 26th, 1869.

NOTES ON LECTURE EXPERIMENTS.

Colouring Carbonic Acid.—Carbonic acid may be coloured brown by nitrogen peroxide. This gas is easily obtained by heating lead nitrate in a test-tube, and by means of a bent tube, conducting the brown fumes into the vessel containing the carbonic acid. Bromine vapour may be used, but the smell is very disagreeable. A simple method of rendering carbonic acid visible is that described by Priestley—"Experiments and Observations on Different Kinds of Air," 3rd edition, 1781, pp. 25-6—viz., by extinguishing lighted candles, paper, &c., in the gas, when the smoke clings to it, rendering it visible. If gunpowder be fired in a large vessel filled with carbonic acid, the smoke, as stated by Priestley, scarcely escapes from the vessel; and, on tilting the vessel thus charged with carbonic acid and smoke, the *pouring* out of the gas is rendered distinctly visible even *from long distances, forming, as* a friend of mine used to say, a "*gascade.*"—C. J. WOODWARD, Midland Institute, May 3rd, 1869.

Hydrogen Bottle.—Thin sheet-lead is worked into the shape of a round bottle, with a wide neck to hold a cork; a gas-cock in the dome or neck of the bottle. Before joining the bottom, a perforated tray of lead is inserted, about 2 inches up into the bottle. A short bit of lead pipe (½ inch) opens into the bottle below. The first idea proposed a cylindrical chamber, fastened to the bottle towards the top, and communicating, by pipe, with the opening below. Into this chamber the liquid is forced by the gas. The suggestion of this year is simple—To put the bottle into any vessel with acid solution. A large quantity of granulated zinc may be put on the tray. This, and the bottle being of lead, galvanic action promotes the evolution of gas, which forces out the liquid, &c, as in the hydrogen lamp. I used the bottle in the simple form this year, and found it all that could be desired. Even the cleaning is easily done. The oxide and sulphate fall through the tray to the bottom and wash out.—RICHARD MCNEVIN; EDWARD CANNON (1862). CHRISTOPHER DUNN (1869), Clongowes.

MISCELLANEOUS.

The Royal Society.—The following is the list of the gentlemen who have been selected by the Council for election into the Royal Society this year: Sir Samuel White Baker, M.A., eminently distinguished as a geographer and explorer of distant lands; John J. Bigsby, M.D., distinguished as a geologist and palæontologist; M. Charles Chambers, director of the Colaba Observatory, Bombay; Mr. William Esson, M.A., of Merton College, Oxford; Mr. George Carey Foster, B.A., Professor of Physics in, and Fellow of, University College, London; William W. Gull, M.D., London, distinguished as physician and as a teacher of the medical sciences; Mr. J. Norman Lockyer, distinguished as an astronomer; Mr. John Robinson M'Clean, C.E., late President of the Institution of Civil Engineers; Mr. St. George Mivart, Lecturer on Comparative Anatomy at St. Mary's Hospital; John Russell Reynolds, M.D., Professor of Clinical Medicine in University College, London; Vice-Admiral Sir Robert S. Robinson, K. C.B., Controller of the Navy; Major James F. Tennant, R.E., late Astronomer at Madras; Wyville Thomson, LL.D., Professor of Zoology, Botany, and Geology in Queen's College, Belfast; Colonel H. E. Landor Thuillier, R.A., eminent as an Indian geographer; and Mr. Edward Walker, M.A., distinguished for his mathematical and literary attainments.

"Previous Sewage Contamination."—A discussion is going on at the meetings of the Metropolitan Association of Medical Officers of Health on the subject of "Contamination of Potable Water by Sewage," and the following are questions having especial reference to *rivers*, on which information is desired:—

Supposing town sewage, discharge of water-closets, &c., to be poured into a running stream, does it undergo oxidation, so that its noxious qualities are lost, and the water restored to a wholesome state? Can you give any instances showing what distance of run in a river will suffice to purify water contaminated with a certain bulk of sewage? Admitting that exposure to sun and air during a run of a certain number of miles in a river will suffice to oxidise dead and decomposing matter, yet there is the hypothesis that *living* matter (*germinal matter*, shapeless organic matter, or germs, cells, or spores of fungi, ova of parasites, &c.) proceeding from diseased bodies may be conveyed by river water, and be the cause of disease. Have you any facts showing that disease of any sort has been propagated by such living matter, after a flow of a certain number of miles down a river? Of two towns on the same river—one above draining into it, the other below drinking from it—do you know any instances of disease propagated from the former to the latter through the medium of the river water? Do you know any facts

showing the propagation of typhoid, or scarlet fever, through potable water?

An adjourned meeting of the Association will be held on Saturday, May 1st, when the discussion will be resumed on Dr. Letheby's paper "On the Methods of Estimating Nitrogenous Matters in Potable Waters, and on the Value of the Expression '*Previous Sewage Contamination*' as used by the Registrar-General in his Monthly Reports of the Metropolitan Waters."

The chief points for consideration in the paper are the following:—1st. Whether rivers fouled by sewage and manufacturing refuse have or have not a self-purifying power. 2nd. Whether the nitrogenous compounds of river and well waters must necessarily have a previous sewage or manure origin. 3rd. Whether, in describing the analytical facts of water examinations, it is proper to use such a speculative phrase as "Previous Sewage Contamination," and to express the result in tons.

Royal Society.—At the President's second soirée, at the Royal Society, on April 24th, 1869, Mr John Browning, of the Minories, exhibited the following novel instruments:—

New Electric Lamp, in which both carbons are moved by the electricity without clockwork.

New Polarising Saccharometer, proposed by Dr. Dupré. This instrument shows the amount of sugar in a solution by a change in the position of a line in the spectrum.

An Improved Spectroscope, in which the dispersion may be instantly doubled or trebled, without changing any of the adjustments.

A new Direct Vision Pocket Spectroscope; containing seven prisms, and an achromatic lens. This instrument will show the absorption bands in coloured fluids, the bright lines in the spectra of metals and gases, and all the principal lines in the solar spectrum.

Professor Graham's discovery, the absorption of hydrogen by palladium: a very compact apparatus for showing the expansion of a piece of palladium by the absorption of the gas, contrived by Mr. Chandler Roberts and Mr. John Browning.

The Zirconia Light.—I learn that the oxyhydrogen zirconia light has been such a success at the Tuileries, having been worked without interruption since the 21st of January, that the Emperor has ordered measures to be taken to render that mode of illumination permanent in front of his palace. During the interval required for getting these new arrangements ready, the court will be lit up with ordinary gas as before. In connection with this fact, M. Tessiè du Mothay has had the Order of Chevalier of the Legion of Honour bestowed upon him, and well has he merited it for his many useful and practical inventions. Whether the process introduced by this gentleman for the commercial manufacture of oxygen from the manganates is the best that can be used for the purpose may, perhaps, be open to discussion; this, at any rate, is true, that it is the only process that has succeeded on a large practical scale up to the present time.—*British Journal of Photography.*

Laboratory of the London Institution.—We learn from the *British Medical Journal* that the Laboratory of the London Institution is about to be abolished. It is proposed to render the Institution more educational than heretofore; and, with this object in view, a class-room for giving elementary instruction in chemistry is to be substituted for the laboratory of research, which is at present occupied by Professor Wanklyn.

Chemical Prize.—The Chamber of Commerce of Nizza has the intention of awarding a premium of 15,000 francs (£600) to any one who discovers and invents a perfectly reliable and easily executed method of detecting an admixture of oil of grains (rape, linseed, poppyseed, &c.) with olive oil, when more than 5 per cent are present. The process must be such as to be manageable by any one, and not entail difficult or dangerous operations, and, moreover, must be perfectly reliable. The committee of the Chamber of Commerce leave all details to the inventor, but will require him to satisfy them and any scientific or practical men they may wish to consult as to the perfection of the process. Communications to be addressed before the 30th of June next to the President of the Oil of Olives Committee of the Chamber of Commerce of Nizza, Alpes Maritimes, France.—*Ann de Chim. et Phys., March*, 1869.

Death of Professor Nickles.—We learn from a short notice of the *Moniteur Belge* of the 14th inst. that Professor Nickles of the Faculty of Sciences of Nancy, Département de la Meurthe, France, has died suddenly, in consequence of accidentally inhaling, as it appears, the vapour of concentrated hydrofluoric acid, while engaged in making experiments to isolate fluorine. The deceased was born at Erstein (Bas-Rhin) on the 30th of October, 1820, was appointed in 1854 to the Professorship he held, and in 1857 was made corresponding member of the Council General of Public Instruction. The printed list of his many and valuable published scientific works occupies a complete page in the well-known *Biographisch-Literarisches Handworterbuch zur Geschichte der exacten Wissenschaften.*

Gold Discovery in Uist.—According to rumours current in Shetland, the Lerwick correspondent of the *Scotsman* writes:—"It seems that gold has been discovered in Uist: it is said to exist in two localities, but whether it will pay for working has not been determined yet. There are two islands named Uist, one named North and the other South; both are situated off the Western Coast of Scotland's mainland, and belong to the Hebridean Group of Isles."

Atomic Weights.—We observe, and have read with great pleasure, a brief, but, at the same time, very clearly and highly finished paper on this subject in Spon's "Dictionary of Engineering." This paper, written, as it evidently is, by a highly accomplished scholar and mathematician, as well as scientific chemist, deserves not only to be read and used by engineers, but will undoubtedly prove very acceptable to many chemists, and especially to students of chemistry, who will find in about eight octavo pages the whole doctrine of Stoichiometry fully, clearly, and comprehensibly explained. The paper alluded to occurs in Nos. 6 and 7 of the work, each part of which may be had separately.

Applied Science in Italy.—We have to acknowledge the receipt of two small papers from M. Emile Kopp, viz., two printed copies of decrees of H. M. the King of Italy, officially published, one dated the 30th of December, 1866, the other the 14th of November, 1867. The former relates to a re-organisation of the Royal Italian Museum, which is a kind of polytechnical school and agricultural college combined. From the different schedules added to this degree, it appears that a very well selected and comprehensive course of lectures is ordered and intended to be given. The latter decree relates to the approval by His Majesty of the regulations made by the Italian Secretary of State for Public Instruction for the Royal School of Applied Science and Engineering at Turin. We have to confess that, looking over the *series lectionum*, nothing of this kind of instruction, or anything approaching to it, established by the State, is to be found in the United Kingdom. No doubt the Italians will, as we hope, highly appreciate the excellent opportunities given them, at a very trifling cost, to obtain that practical and scientific instruction they are highly in want of, in order to be enabled to fully develop the eminent natural resources of their beautiful country, once the chief seat and depository of learning, art, and science in the world.

On the Use of Tungstate of Baryta in Painting.—(Extract from a letter from M. Sace to M. Dumas.)—"At the request of a landscape painter, I was induced to examine in succession all our insoluble white compounds, with regard to their adaptability to painting purposes. Tungstate of baryta answers perfectly, covers as well as white-lead, and is as unalterable as zinc white. It has been employed by this artist for three months, and was found equally successful in oil or water colours, chromolithogra-

phy, and even in making white impressions on a black ground. This harmless substitute for the injurious white-lead is prepared on a large scale in Paris by M. E. Rousseau."

Extraction of Oxygen from the Air.—There is a competitor in the field now, in the shape of a process for extracting the oxygen from the air after the manner of the respiratory organs of animals. MM. Loire and Montmagnon propose to take advantage of the well-known property of wood charcoal, alkaline solutions, and blood of absorbing oxygen from the surrounding air, and condensing it between their molecules, either by a physical or chemical affinity. It is proved, by experiment, that 100 measures of wood charcoal, freshly burnt, absorb 985 of oxygen, and only about 705 of nitrogen. The blood of animals and solutions of phosphate and carbonate of soda absorb rapidly, according to the amount of surface exposed to the air, about 12 per cent of oxygen, and only two per cent of nitrogen. The proposed method of using these facts is this:—Pump out the oxygen and nitrogen from the substances used to absorb it by means of an air-pump; pass the mixture through fresh-absorbing *media in vacuo*; re-extract, and repeat the operations as often as required. In this way an oxygen is obtained very free from nitrogen, and at an extremely cheap rate. The reservoir which contains the charcoal, &c., may be compared to the lungs of animals, and the air-pump to the pulmonary apparatus of the same nature. If this process should succeed upon a commercial scale, it will be a beautiful example of the imitation of one of nature's great processes, and its adaptation to the wants of man.—*British Journal of Photography.*

Astronomical Clock for Beauvais Cathedral.—Although not exactly belonging to the subjects the pages of our paper are devoted to, we abstract from the French journal *Les Mondes*, the following:—The clock is destined to be placed within the cathedral church; it is a piece of furniture constructed according to the designs of the Rev. Father Piérart, S.J., 12 metres in height, 5 metres wide, and 2 metres deep; it contains fifty-five dial plates, and indicates eighty different things; the internal work contains 90,000 parts. The clock indicates the exact time for twenty different parts of the globe, indicates also the precise moment of the rising and setting, and meridian passage of the sun and moon at Beauvais for every day of the year, and, moreover, the rising and setting of no less than 10,000 stars for the same place; besides this, other things, as saints' days, &c. At present the clock is at Paris, and may be seen in the Palais de l'Industrie. The entire work is highly spoken of, both as work of applied science and of fine art. The clock has been made, it appears, at the desire and expense of Magyar Grignoux, Bishop of Beauvais.

Statue to Oersted.—We learn from *Cosmos* that a committee has been formed at Copenhagen with the intention of erecting a suitable monument in honour of the great Danish *savant*. A statue, representing the illustrious man, is ordered to be made by a Danish sculptor, named Ferichau, and is intended to be placed in a prominent situation in the capital of the kingdom.

Accident to Professor Bunsen.—The *Carlsruhe Gazette* relates that an accident the other day befell the celebrated chemist Bunsen. He had prepared a quantity of a composition recently discovered, and had dipped his fingers in the vessel, to see if the composition was dry, when that slight pressure sufficed to ignite the whole mass, and a flame arose, which scorched the experimentalist rather severely in the hands and face. He is expected, however, to recover in the course of ten days or a fortnight.

Mineral Caoutchouc.—Recent communications from Adelaide, South Australia, have made known the discovery in the southern portion of the colony of a remarkable *carboniferous* substance, which hitherto has only been found in small quantity in the coal strata of Derbyshire (England). It is a mineral caoutchouc, so called from its general appearance and elasticity. In Australia it is found on the surface of the sandy soil, through which it would appear to exude from beneath, as, burnt off occasionally by the bush fires, it is again found after the winter season, occurring in quantity and of varying thickness. Analysis proves it to yield 82 per cent or more of a pure hydrocarbon oil; its value for the manufacture of gas there will be great, and it is also believed to be applicable to the making of certain dyes. The discovery is also important from its indication of the existence of oils or other carboniferous deposits. This material, known in mineralogy as elaterite, is also found in a coal pit at Montrelais, near Nantes, France, at Neufchâtel, and on the island of Zante. According to the analyses of the late Professor Johnston, of Durham University, it is a hydrocarbon containing from 83·7 to 85·5 per cent of carbon, and from 12·5 to 13·28 per cent of hydrogen. The variety found in Derbyshire (near Castleton) has a specific gravity varying between 0·9053 to 1·233; the substance is highly inflammable, its colour blackish brown, its lustre resinous.—*Mining Journal.*

A Curious Laboratory.—We read in the *Lancet* that M. Sainte-Claire Déville, in connection with his scheme for substituting the mineral oils for coal as fuel in the French fleet, has undertaken a series of experiments, in which he will study the effects of pressure on various phenomena, and especially the causes of light in flame, of combustion, &c. In order to pursue these researches, it has been thought necessary to construct a large iron laboratory, capable of receiving the experimenter with all his apparatus, and which may be subjected to an extraordinary atmospheric pressure by means of suitable pumping apparatus. This iron safe has the form of a vast cylinder, surmounted by two chimneys, one serving to connect the pressure pumps, and the other to admit the operator and his apparatus. The experiments will be conducted by M. Sainte-Claire Déville and some other *savants*, and will involve a certain degree of danger. No doubt of this latter assertion; *queritur*, how their lungs and brain will feel under increased atmospheric pressure?

Ozonisation of Hydrocarbon Oils.—M. Grotowsky, of Halle on the Saale, has made known some interesting facts on a new property of various hydrocarbon oils, which he has discovered. Exposing various kinds of oils in glass flasks to the rays of the sun for a period of three months, he found invariably that they absorbed oxygen and converted it into ozone. The air was ozonised even in well-corked vessels, the effect being, however, to some degree dependent upon the colour of the glass. The respective results were noted after the lapse of three months, American kerosene, from petroleum which had been exposed to light in white uncovered glass balloons, had become so strongly ozonised that it scarcely burned. The originally bluish white oil had assumed a vivid yellow colour, and the specific gravity was found to have increased 0·005. American kerosene, which had been kept in the dark for three months, did not show any ozone at all, and burned satisfactorily. The oils were exposed from April to July, 1868; those which had become strongly ozonised had also suffered a distinct change in odour, and the corks were bleached as if attacked by chlorine, while the other oils had remained unchanged in these particulars. These results are fully confirmed by the experience of the consumers as well as of the dealers in these oils, who all avoid obtaining "old oils" as they call them. It appears that re-distillation, with quick-lime and clean iron nails, restores the oils to their original state and properties.—*Engineer.*

The Chemical Society, wishing to honour the memory of its late distinguished Fellow Professor Faraday, and at the same time to promote the personal intercourse of the Society with eminent foreign chemists, has decided upon instituting a Faraday Medal, to be awarded, from time

to time, to some foreign chemist of distinction, upon his accepting the invitation of the President and Council of the Chemical Society to deliver a lecture to its Fellows. The inaugural lecture will be delivered on June 17th by M. Dumas, Master of the French Mint, a personal friend of Professor Faraday's, and well known to chemists all over the world as the author of many important investigations in organic chemistry, and especially as the introducer of the doctrine of chlorine substitutions. By permission of the managers, M. Dumas's lecture will be delivered in the Theatre of the Royal Institution, associated for so many years with Professor Faraday's own expositions. The Fellows of the Society and their friends will dine together at Willis's rooms on June 18th, on which occasion M. Dumas is expected to be present as a guest.

Depth of some Recently Bored Wells.—As an evident proof of the greatly advanced desire to procure for domestic purposes good and pure water and a plentiful supply thereof, it is interesting to learn that within the last five years the undermentioned wells have been bored, some of them at very great expense. At Antwerp, to a depth of 165 metres below the surface; at Ostend, 300 metres; at Oeynhausen, Prussia, 696 metres; at Mondorff, Grand Duchy of Luxemburg. 730 metres; at Passy, Paris, 624 metres; at Rochefort, Charente Inférieure, France, 816 metres (this is the deepest bored well now existing in Europe). At Grissee, Soerabaya, Java, a well has been bored to a depth of 549 metres through hard rock. The deepest boring in Holland has been carried to a depth of 182 metres below sea level at Gorkum, at which depth in that locality, the tertiary formation has been reached, but water only of very indifferent quality; with this exception all the above-named wells yield water in abundance, and of great purity.

Quantitative Estimation of Sulphocyanides.—According to experiments instituted by Dr. Rüdorff, the estimation of the aforenamed salts, when neutral and soluble in water, is perfectly reliable when executed by means of titration with a neutral soluble silver salt. Experiments made by the author with properly recrystallised sulphocyanides of ammonium and potassium yielded exactly the theoretical quantity; the salts experimented with had been purified by recrystallisation from alcohol and afterwards drying. *Poggendorff's Annalen.*

Westphalian Iron Pyrites.—At the Paris Exhibition of 1867, there was a single block of pyrites from the Sicilian Pyrites Company, in Westphalia, weighing 4500 kilos. This piece was sent from the neighbourhood of Altenhunden-on-the-Lenne, and the mine yields now yearly 100,000,000 kilos of this ore, which, according to an analysis made by Dr. Fresenius, contains from 42 to 45 per cent of sulphur, from 39 to 58 per cent of iron, and 0·02 per cent of arsenic. On an average, about 43 per cent of sulphur in this ore is available for making sulphuric acid.—*Bul. de la Soc. d'Encouragement.*

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

368. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in the manufacture of ice and of the agents employed therein, and in the apparatus connected therewith."—A communication from C. Tellier, Paris.—Petition recorded February 6, 1869.

1083. J. Dewar, M.D., Kirkcaldy, Fifeshire, "Improvements in treating certain substances for food and for manure."—April 9, 1869.

1103. E. C. C. Stanford, Glasgow, N.B., "Improvements in applying, treating, and utilising materials for deodorising solid, liquid, and gaseous matters."—April 10, 1869.

1151. W. Wright, Mostyn, Flint, "Improvements in treating ores to obtain copper and other metals therefrom."—April 14, 1869.

1197. H. Aitken, Falkirk, N.B., "Improvements in treating iron ores or iron stones."—April 19, 1869.

1203. A. Brady, Stratford, Essex, "Producing pure iron direct from crude iron ore."—A communication from E. Brady, Philadelphia, Penn., U.S.A.—April 20, 1869.

1224. M. Henry, Fleet Street, London, "An improved mode of obtaining pyro-phosphate of lime."—A communication from E. Deligny Boulevard Saint Martin, Paris.

1227. C. D. Abel, Southampton Buildings, Chancery Lane, "A new or improved method of, and materials for the preparation of mural paintings."—A communication from P. Oury and P. Cousin, Rue de Trois Freres, Paris.—April 21, 1869.

1244. A. Borgnet, Swansea, South Wales, "Improvements in the manufacture of paint."—April 22, 1869.

982. J. C. Lee, Ashton-on-Mersey, Cheshire, "Certain methods of collecting excreta, and of treating the same in order to render them comparatively innocuous, and to obtain a useful product or useful products therefrom."—Petition recorded April 1, 1869.

1256. H. E. Newton, Chancery Lane, "Improvements in puddling iron."—A communication from C. Hewitt, Trenton, New Jersey, U.S.A.—April 23, 1869.

1278. T. Forster and P. B. Cow, jun., Streatham, "Improvements in compounds containing india-rubber, gutta-percha, or balata, and in the manufacture of such compounds."—April 24, 1869.

1317. A. Meredith, Newgate Street, London, "Improvements in the manufacture of iron and steel."—April 28, 1869.

1143. P. A. Blake, Highbury, Middlesex, "An improved safety explosive compound, and the apparatus connected with its use."—Petition recorded April 14, 1869.

1193. J. Horsley, Cheltenham, Gloucestershire, "Improvements in the manufacture of blasting powder or explosive compounds."—April 19, 1869.

1260. J Major, W. Wright, Swallow Street, Middlesex, and G. H. Jones, Alpha Road, Middlesex, "A new or improved manufacture of white-lead, and apparatus employed therein."—April 24, 1869

1361. P. Southern, Top Lock, Aspull, near Wigan, Lancashire, "Improvements in furnaces."—May 3, 1869.

1380. W. MacKean, Paisley, Renfrewshire, "Improvements in the manufacture of cattle food."

1381. E. H. Richmond, King William Street, London, "Improved apparatus and process for preserving fresh meat and other animal food, fish, poultry, and game; also ingredients, matters, or substances to be used in combination with the said apparatus."

1383. H. Highton, M. A., Brighton, Sussex, "Improvements in making, hardening, and preserving artificial stone, and in preserving the surfaces of walls and other surfaces."

1388. T. Welton, Grafton Street, Fitzroy Square, Middlesex, "A new method of applying oxygenated and other gas-charged charcoal, for curative and other purposes."—May 5, 1869.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

1290. S. Oakman, Boston, Mass., U.S.A., "Improvements in the construction of smelting and other furnaces."—Petition recorded April 26, 1869.

NOTICES TO PROCEED.

3837. G. Hadfield, Lancaster, "Improvements in the manufacture of varnish."—Petition recorded December 17, 1868.

3830. C. Liebermann and C. Graebe, Berlin, Prussia, "Improvements in preparing colouring matters."—December 18, 1868.

3870. P. Spence, Newton Heath, near Manchester. "Improvements in the manufacture of alum and aluminous salts."—December 19, 1868.

3893. W. E. Gedge, Wellington Street, Strand, Middlesex, "A novel bituminous composition."—A communication from F. Labat and J. Merle, Boulevard Bonne-Nouvelle, Paris.—December 21, 1868.

375. C. D. J. Seitz, Bury, Lancashire, "Improvements in the construction of furnaces and pans for the recovery of the soda from the waste lyes resulting from the boiling of esparto grass, straw, or other fibrous substances, in the working and incinerating of the residue resulting from evaporation."—February 6 1869.

600. J. Townsend, Glasgow, N.B., "Improvements in extracting and in refining oils and other products from mineral and other materials containing carbon and hydrogen, and in apparatus therefor."—February 26, 1869.

969. G. Wells, Westminster, "Improvements in separating copper and bismuth from ores containing metals either separately or combined with other metals."—A communication from T. Y. Cotter and C. L. Dubois, Adelaide, Australia.—March 31, 1869.

3930. W. H. Walenn, Tufnell Park, West Holloway, Middlesex, "Improvements in the electric deposition of copper and brass."—Petition recorded December 24, 1868.

3967. S. F. Healey, Pimlico, Middlesex, "Improved means of operating upon stick or gum lac, for the extraction of colouring matter or lac dye, and for the production of shell-lac."—December 30, 1868.

4. W. M. Williams, Sheffield, "Improvements in fettling or lining puddling furnaces used in the manufacture of iron and steel."—January 1, 1869.

164. A. M. Clark, Chancery Lane, "Improvements in the manufacture and refining of sugar."—A communication from L. J. F. Marguerritte, Boulevart St. Martin, Paris.—January 18, 1869.

1178. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of heavy hydrocarbon oils, and in apparatus used therein."—A communication from J. Merrill, Boston, Mass., U.S.A.—April 16, 1869.

3945. E. Butterworth, Calder Cottage, near Rochdale, Lancashire, "Certain improvements in or applicable to furnaces."—Petition recorded December 26, 1868.

[English Edition, Vol. XIX., No. 496, pages 272, 270, 268; No. 492, page 227; No. 493, pages 238, 239; No. 495, page 263.]

3965. A. G. Cazalet, Rue Gaillon, Paris, "Improvements in the manufacture of steel, and in the apparatus employed therein."—December 30, 1868.

26. W. Prosser, Lancaster, "Improvements in the purification and bleaching of oils, gums, and resins and spirits."—January 5, 1869.

905. J. J. Bodmer, Newport, Monmouthshire, "Improvements in the manufacture of iron and steel, and in the apparatus to be employed therein, part of which improvements are also applicable to the treatment of other metals and alloys."—March 25, 1869.

1083. J. Dewar, Kirkcaldy, Fifeshire, "Improvements in treating certain substances for food and for manure."—April 9, 1869.

NOTES AND QUERIES.

Chemical Infinity.—Appleton's Journal contains in its first number a calculation by Berthelot, the eminent French chemist, of the number of combinations which may be made of acids with certain alcohols. He says, if you give each compound thus possible a name, and allow a line for each name, and then print 100 lines on a page, and make volumes of 1000 pages, and place a million volumes in a library, you would want 14,000 libraries to complete your catalogue.

The Gulf Stream.—Captain Maury considers the Gulf Stream equal to a stream 32 miles broad and 1200 feet deep, flowing at a rate of 5 knots (38,415 feet) an hour. This gives 6,166,700,000,000 cubic feet per hour as the quantity of water conveyed by this stream. Sir John Herschel's estimation is still greater; he considers it equal to a stream 30 miles broad and 2200 feet deep, flowing at the rate of 4 miles an hour; this makes the quantity 7,359,900,000,000 cubic feet per hour. Sir John estimates the temperature of the water at 86° F.—*Engineer.*

Carbonic Acid.—Mr. Kernan evidently forgets that common washing soda contains—(1) more than half its weight of water of crystallisation, and (2), unless purposely purified, is contaminated with some undecomposed chloride of sodium and sulphate of soda, containing, moreover, caustic soda; the substance being, moreover, soluble in water, is not so well adapted also on economical grounds for the production of carbonic acid gas as is white marble, or any other lime-stone, which, weight for weight, will yield more gas than the common washing soda. Of course it may be used, but it has no advantage.—Dr. A.

An Excellent Indelible Ink may be prepared by rubbing up 1 drachm of aniline black with a mixture of 60 drops of concentrated hydrochloric acid and 1½ ounces of alcohol. The resulting deep blue liquid is then to be diluted with a hot solution of 1½ drachms of gum-arabic in 6 ounces of water. This ink does not corrode a steel pen, and is affected neither by concentrated mineral acids nor by strong lye. If the aniline black solution be diluted with 1½ ounces of shellac, dissolved in 6 ounces of alcohol, instead of with the gum-water, an aniline black is obtained, which, after being applied to wood, brass, or leather, is remarkable for its extraordinary deep black colour.—*American Artisan.*

Supply of Water for Domestic Purposes.—From a brief report of the proceedings of the Municipal Council of Nismes, France, we copy the following figures, indicating the quantity of potable water supplied daily in litres to the under-mentioned places for each head of inhabitants

		litres.
	Ancient Rome	1500
	Rome of present day	900
	New York	360
France.	Carcassonne	400
France.	Besançon	270
France.	Dyon	270
France.	Bordeaux	170
	Paris, at present	125
	" in 1871	250
	London	95
	Lyons	85
	Brussels	80
	Genève	74
	Nismes	200

Action of Heat on Peroxide Salts of Iron.—The observation of M. Debray, reported in your last issue (*Am. Repr., June*, 1869), on the action of heat upon the peroxide salts of iron, explains a matter that I have almost invariably noticed for several years past, in testing commercial sulphate of soda, or salt-cake. As manufactured on the large scale, this substance always contains a small amount (from 0·25 to 0·5 per cent) of the sulphate of peroxide of iron, and, when dissolved in cold water, forms a colourless solution, even when concentrated. If hot water be used, or if the cold solution be gradually heated, it immediately becomes quite brown-coloured, and particles of hydrated peroxide of iron are observable, the static equilibrium having been in this case disturbed by the sulphate of soda present.—Bristowe.

"*How to Prevent the Spread of Scarlet Fever.*"—As far as it has been possible to ascertain, the miasma of scarlet fever, *febris scarlatina maligna*, is a fixed contagium, not volatile, nor to be met with at a distance from the patient who, while suffering from the disease, produces the peculiar miasma, about the real nature of which, be it a germ, or something else, nothing is precisely known; it is, however, a fact that keeping disinfectants in the locality where a patient suffering from the disease is confined, is beneficial as a prophylactic for those attending upon him. Green copperas, sulphate of protoxide of iron, would not be so fit to use in this special case as sulphurous acid, hypochlorite of lime, or carbolic acid. Green copperas may disinfect drains and cesspits, but would be of little avail in this particular case, the less so as *the evident proof has* not been given that scarlatina is propagated in *the way spoken of by "Sanitas."* This discussion should rest here, as it is not one to which the columns of this paper are open, being a purely medical subject.

On the Cause of a Pink Colour in White Lead Corrosions.—It appears, from the experiments of Mr. W. Baker (*Phil. Mag.*, May, 1869), that not, as he formerly supposed, oxide of copper, but metallic silver, when present in lead in small quantity, is the cause of the pink colour now and then observed by white lead manufacturers. Analysis of 5,000 grs. of white corrosion gave:—CuO, 0·0050; FeO, 0·0022; NiO, trace; Ag, 0·005, per cent. Pink corrosion:—CuO, 0·0060; FeO, 0·0022; NiO, 0·0013; Ag, 0·0058 per cent. A decided colour, which is uniform throughout the mass of the corrosion, is obtained when the silver amounts to about 1½ ozs. per ton. The author ascertained that the silver is present in metallic, but of course finely divided, state.

Discovery of Natural Gas.—Some workmen, while boring for water at Middleton Hall, Uphall, Linlithgowshire, observed that gas escaped from the bore-hole. They applied a light, and instantly the gas blazed up in a beautiful white light, and continued to burn with increasing force, until it was extinguished by the workmen in order to resume their boring operations. The stratum from which the gas evolves is well known to mineralogists as the marl which overlies the rich bituminous shales of this district. Judging from the extent of the source of supply, and the richness of the gas, it might be profitably employed for heating and illuminating purposes, and the shale worked for oil making. The parish of Uphall is contiguous to Bathgate, well known for the Boghead coal being found in its neighbourhood.

Mutual Decomposition.—In the employment of common reagents in an aqueous analysis, it is usual for the test employed and the substance sought, if present, to mutually decompose each other, and to form salts of a different nature—for example, the determination of sulphuric acid in a soluble sulphate by means of a soluble salt of barium; the acids in this case are transposed, because of the stronger affinity of the acid of the first base for the base of the second. But in the dry way it frequently happens that, at an elevated temperature, acids and bases lose the stronger affinity, and combine with other bases and acids, for which at ordinary temperatures they have a lesser affinity—for example, sulphate of baryta and carbonated alkali. Now, in the case of a mixture of sulphate of lime and carbonate of magnesia, I had no standard chemical work for reference to ascertain whether, on application of heat, these salts undergo decomposition—carbonate of lime and sulphate of magnesia resulting, or more probably caustic lime and sulphate of magnesia, as such was my impression; hence my note appearing in your issue of the 23rd ult. I am obliged for your answer of last week, but thinking so an apparently simple matter—as to whether these salts do or do not decompose at a high temperature, say a red heat—must be well known to those skilled in chemistry, is my excuse for again writing.—W.

Purifying Water.—(Report of the Netherlands Committee.)—It is a well-known and generally observed fact that the water of rivers, canals, and some lakes is never quite clear. This turbidity, which often remains even after many days of quiet rest, is partly due to inorganic substances floating about in the water and suspended therein, but is far more frequently caused by matters of an organic nature too minutely divided and too small to be readily recognised, even by a powerful microscope. The researches of some of the members of this report have undeniably proved that, at least as far as the Netherland waters they submitted to research are concerned, this turbidity is due to extremely minutely divided clay, by the aid of which a great deal more of organic matter than could otherwise remain suspended is kept in such an extreme state of division as to pass through filters and not deposit, even after many days of rest. When, to such kinds of water, a solution of alum (from 1-50,000th to 1-100,000th of the bulk of the water) is added, it will be observed that after a longer or shorter lapse of time a flocculent precipitate is formed, which is either alumina or a basic sulphate thereof, which flocculent material takes up all the turbidity of the water, leaving that perfectly clear; the precipitate thus formed has been submitted to chemical tests, and it was found to contain a large quantity of organic matter, and to yield, on being heated with soda-lime, ammonia very largely. Since the committee was instructed to ascertain and discover the means of improving the condition of the potable waters where it was required, this especially also applied to the towns and villages whose chief supply of water for domestic and drinking purposes depends upon that of the river Maas, along the banks of which, in the lower portion of its seaward course, the population is entirely dependent upon its water; which has been almost from time immemorial known to produce, in those not accustomed to its daily use, a diarrhœa, which in certain individuals is accompanied by very unpleasant, if not always, therefore, dangerous symptoms. The water of this river has been analysed over and over again by many eminent scientific chemists, and has been submitted to microscopic research, but no trouble, nor anything science could, armed with its best weapons, bring to bear on this research, has ever revealed the precise cause of this peculiar property, which is not possessed by the water of the same river, nor also by that of the Rhine, higher up its course. For curiosity's sake, we here quote the result of one of the most recent analyses of this water taken at flood tide at Rotterdam:—Physical properties—very turbid, does not become clear on standing, is not rendered clear on addition of a few drops of hydrochloric acid; taste—not quite unpalatable; solid residue—dried at 120° C., yielded, for 1 litre, 0·195 grm., containing 0·055 of combustible matter; earthy salts—0·0975 grm., containing 0·048 sulphate of lime, chlorides of alkalies, 0·0233; ammonia—none; slight trace of nitrates; dry residue had a yellow colour before ignition. It is a highly important fact, and one of very general importance to learn, that Dr. J. W. Gunning, of Amsterdam, has found that the perchloride of iron added to this water (and the same applies to far more foul waters experimented upon) has the effect of rendering it perfectly wholesome and even agreeable for use. To one litre of water, 0·032 grm. of the dry salt just alluded to, and previously dissolved in pure water, are added,

and, after well stirring the liquid, it is left quietly standing, to settle, for fully thirty-six hours. A series of very carefully made experiments has proved that no free hydrochloric acid (the quantity thereof contained in the above-stated weight of perchloride of iron only amounts to 0·021 grm.) was left in the clarified and purified water, but in order to suit the application on the large scale, and to make assurance doubly sure, as regards any acid or perchloride being left undecomposed, or rather uncombined, with the organic and inorganic matter of the water, Dr. Gunning has advised that a small, but equivalent, quantity of crystallised carbonate of soda should be also added some hours previous to beginning to take the purified water for use. At Dr. Gunning's request, a scientific gentleman of high attainments, who happens to have an excellent opportunity, near Rotterdam, to try on the large scale this process, has submitted it to practical test, and a quantity of no less than about 240,000 litres of Maas water, taken at all times of the year, has been treated by this process, and thereby rendered perfectly fit for use, and consumed by various parties, has proved to have been entirely deprived of its property of causing diarrhœa; moreover, the medical officer in charge of the crew of Her Majesty's corvette the Lynx, moored off Rotterdam, in the river, has applied this process to the water taken from the river, and found by experience that the thus purified water has even the good effect of restoring to health such of the crew as had been incautiously drinking the not previously purified Maas water. It is, when using this means of purifying bad water, of great importance to let the sediment quietly settle; it occupies about 4 per cent of the bulk of the water, which on the large scale will, for security's sake, be submitted to a filtration through fine well-cleansed sea-sand before being sent through the mains of the large waterworks intended to be established near Rotterdam for the supply of that town. The quantity of crystallised carbonate of soda which is equivalent to 0·032 grm. of dry perchloride of iron is 0·085 grm.; both these quantities are the maximum required to render the Maas water perfectly pure, even at the time when it is most turbid; comparative experiments have conclusively proved that the application of this process is very superior to filtration of the water, even through animal charcoal. The result obtained with the Maas water having been so eminently successful, the committee has applied this method to the purifying of water otherwise non-drinkable, such as is met with in many of the smaller canals, brooks, and also pumps yielding surface water of bad quality in many parts of the kingdom, and the results obtained are such as to justify the order that this method of purifying must be applied by authority to a class of waters which, thus treated, become available for use. The precipitate formed by the addition of the perchloride of iron and carbonate of soda, both previously dissolved, has been proved, by accurate analysis, to contain a large quantity of organic matter, which, on being ignited with soda-lime, yielded ammonia very largely; analysis has also proved that, as regards the Maas water, the only addition to its inorganic constituents is that of one part of chloride of sodium, by weight, in 40,000 parts of water by the application of this process. Dr. Gunning has found that the effect of the perchloride is not so conspicuous with some well waters containing much carbonic acid; while, moreover, there may exist in some of these kinds of waters, either in quantity or quality, inorganic salts which delay or altogether impede the peculiar mode of flocculent precipitation observed with the above-named Maas and other waters to take place after addition of the iron salt.

Cryolite.—We should be glad to know of a firm who are sellers of cryolite or Greenland spar.—J. B. and Co.

Sulphate of Manganese.—What is the annual consumption of sulphate of manganese, its price per ton, and what it is principally used for, and who are the principal buyers of it?—WM. BLENCH.

Bread for Diabetes.—Can any of your courteous readers supply me with information respecting the manufacture of the bread which is prescribed in the treatment of diabetes?—FARINA.

Alizarine.—Is MM. Graebe and Liebermann's discovery (the artificial preparation of alizarine) likely to be of any commercial value? Madder alizarine of commerce being extracted and sold profitably at less than £10 per cwt.—B. S.

Soldering without Fire.—Information wanted concerning the brazing or hard soldering of copper without fire, and merely by the application of a preparation made for the purpose, quite independent of any galvanic arrangement.—FLUORINE.

Carbonic Acid.—Referring to the query of Mr. E. Kernan in your number of April 30th (*Am. Repr., June*, 1869, *page* 336), and referred to by Dr. A. in that of May 7th (*Am Repr., July*, 1869, *page* 30), may I venture to suggest that native carbonate of barium would be a more economical source of carbonic acid than the substance named? When treated with muriatic acid, chloride of barium is formed, and the carbonic acid gas is given off very freely. If sulphuric acid be added to the barytic salt which is in solution, sulphate of barium will, of course, be precipitated, and pure hydrochloric acid recovered. The price of the carbonate of barium is 7s. per cwt.—FREDK. BRABY.

On the Characteristic Differences and Tests for the Detection of some Fatty Oils.—Dr. Sacc, of Neufchâtel.—*Castor Oil.* Nearly colourless, very viscous, faint odour; becomes more fluid on being heated; becomes bright orange coloured in contact with nitric acid. The oil does not develope much heat when brought into contact with sulphuric acid; its colour becomes thereby cinnamon-brown. When the mixture is put into water it forms a mass at first insoluble, which, however, becomes gradually decomposed, the oil floating on the top evidently having undergone little or no change at all. Acetic acid does not act upon the oil at all; soda forms an emulsion to some extent with the oil, but fails to effect this completely; alcohol dissolves some of the oil. With solution of nut-galls, a portion of the oil is converted into an emulsion; liquid ammonia is without action; with nitrate of silver a yellow colouration appears at the point of contact; chloride of gold gives rise to the formation of an emulsion, and is itself partly reduced to metal. *Linseed Oil* (*Raw*).—Colour deep yellow; odour acrid; when heated, its colour becomes more pale, and the oil foams strongly; with nitric acid, olive-coloured tinge. Concentrated sulphuric acid causes much disengagement of heat, and the colour of the oil becomes dark brown; the mixture swells considerably; sulphurous acid is developed as well as formic acid. The residue is insoluble in water, and gives off the smell of asphalt; acetic acid, no action; with caustic soda solution, yellow emulsion; to a small extent soluble in alcohol. With solution of nut-galls the oil becomes solidified, forming a solid yellow-coloured mass; liquid ammonia causes it to form an emulsion. No action with nitrate of silver; chloride of gold is readily and completely reduced to the metallic state when in contact with this oil. *Poppy-Seed Oil.*—Colour bright yellow; no perceptible smell; no change on being heated; no action with nitric acid. With sulphuric acid very little heat is developed, and the oil is changed into a cinnamon-brown coloured magma insoluble in water. Becomes slightly turbid with acetic acid; forms a white emulsion with soda; not soluble in alcohol, which latter fluid floats on the oil; becomes slightly turbid with solution of nut-galls; forms a white emulsion with liquid ammonia. With solution of nitrate of silver a white emulsion is produced, only, however, at the point of contact between the oil and the solution; with chloride of gold a trace of reduction to the metallic state takes place. From these experiments we learn—(1) that nitric acid only produces a colour with ground-nut, cotton-seed, sesame-seed, castor, linseed, nut, and whale oils; (2) that sulphuric acid combines with all the oils, thereby producing compounds soluble in water in the case of olive, colza, ground-nut, cotton-seed, and sesame-seed oils; (3) that the solution of nut-galls is without action upon olive, nut, and whale oils, that all the others are made into emulsions, and that linseed oil is coagulated by the said solution; (4) that caustic soda solution forms emulsions with all the oils except that of cotton-seed, the castor oil, and nut oil; (5) that nitrate of silver becomes blackened only when in contact with colza oil; (6) that chloride of gold forms emulsions with all the oils and is in contact with all reduced to metal, excepting in the case of olive and colza oils; with the former of these and the reagent alluded to, no reaction takes place at all, and with the latter an emulsion is only formed, no reduction taking place.—*Rev. Hebd. d. Chim.*, No. 23, 1869.

On the Estimation of the Iodine of Commerce by Volumetrical Analysis.—M. Bobierre dissolves a weighed quantity of the iodine, the true value of which has to be estimated, in a concentrated solution of iodide of potassium, the solution is diluted to 100 c.c., and is dropped into an alkaline solution of arsenious acid of known strength. Instead of using starch water, as a means of recognising the end of the reaction, the author adds a few cubic centimetres of benzol to the solution of arsenious acid, and ceases to add more of the solution of iodine as soon as the former solution becomes rose-coloured. The arsenical solution is made by weighing off 49·95 grms. of arsenious acid and 14·5 grms. of crystallised carbonate of soda, and dissolving these in 1 litre of water, representing 12·688 grms. of iodine to the litre; 10 c.c. of this solution are taken for each assay, and 4 c.c. of benzol are added.—*J. de Pharmacie.*

Alizarine.—It is as yet impossible to answer this question, since Messrs. Graebe and Liebermann do not manufacture on a sufficiently large scale to judge of the commercial success of their process.—F.

Bread for Diabetes.—Bread composed of gluten of wheat without starch, or bran-cakes baked with eggs, have been recommended. It is very likely that some of the higher-class bakers of the West End shops keep, or at least, if required, make, bread of this kind, as is the case in Paris.—H. C. S.

Bread for Diabetes.—Take coarse wheat-bran, wash it with water on a sieve until the water passes through clear, dry it in an oven, and grind to a fine powder by a mill. Take seven eggs, 1 pint of milk, ½lb. of butter, a few caraways or some powdered ginger, and make the whole into a paste with a sufficiency of the bran-flour. Divide the mass into seven equal parts, and bake each separately in a saucer by rather a quick oven; time about twenty minutes. Another way is to take potatoes, 4 lbs.; rasp them, and wash on a sieve as above; 3 ozs. mutton suet, three eggs, 2 ozs. butter, 1 drachm carbonate of soda; mix, and add ½ fluid oz. pure *dilute* hydrochloric acid Lond. Pharm. Divide into two cakes, and bake immediately in a quick oven until nicely browned.—G. A. K.

Sulphate of Manganese.—This substance is not used in the arts or manufactures to any extent; those who want it (as for instance calico-printers) either make it themselves or purchase it from manufacturing chemists, who only make it in any quantity when ordered; as to its price, any price-list of wholesale firms will give information.—L.

Carbonic Acid.—Carbonate of barium is by no means a mineral found in such quantities as to render it particularly adapted to the manufacture of carbonic acid on account of cheapness as compared with white marble, thousands upon thousands of tons of which, in the shape of chips, are burned for lime; and which, in small quantities, at stone-masons' and marble-work yards, may be had almost for the mere trouble of picking them up.—A.

Magnesian Cement.—I have been trying the magnesian cement—an oxychloride of magnesium—discovered by M. Sorel, of Paris, and am struck with its cementive powers, even when mixed with much foreign matter. An invention apparently so excellent can hardly have been allowed to remain unnoticed without some reason. Are its hydraulic properties deficient? Are the materials too expensive for application on a large scale?—R.

Black Ink from Elder Berries.—The bruised berries are placed in an earthen vessel, and kept in a warm place for three days, then pressed out and filtered. The filtered juice is of such an intense dark colour that it takes 200 parts of water to reduce it to the shade of dark red wine. Add to 12½ quarts of this filtered juice 1 oz. of sulphate of iron and the same quantity of crude pyroligneous acid; and an ink is prepared which, when first used, has a violet colour, but when dry is indigo-blue black. This ink is superior in many respects to that prepared with

galls; it does not become thick so soon, it flows easier from the pen without gumming, and, in writing, the letters do not run into one another.—*Deutsche Ind. Zeitung.*

Oxychlorides.—The white precipitate given by $BiCl_3$ in water is called an *oxychloride* by certain chemical writers (Bence Jones, H. Watts), whilst that given by $SbCl_3$ is called a compound of the trioxide and trichloride. Is not the one as much a compound of the trioxide, &c., as the other? Chemistry aims at being exact, and certainly needs it. Why not be exact in minor matters if possible? Could the first be given as in the following equation:—

$$3(BiCl_3)+3(H_2O)=BiCl_3+Bi_2O_3+6HCl,$$

and the second—

$$3(SbCl_3)+3(H_2O)=SbCl_3+Sb_2O_3+6HCl,$$

or could not both terms be got quit of, and these precipitates be classified under the basic salts?—JOHN D. MACDONALD, Urquhart, Inverness.

Wood Pulp.—According to M Ouvli, who has thoroughly investigated this subject, excellent results are obtained when for a hundredweight of wood pulp from 400 to 800 grms. of oxalic acid are used; this acid has the double advantage of bleaching the colouring matter already oxidised, and of neutralising the alkaline principles which favour such oxidation. He adds to the oxalic acid one pound, or a little more, of sulphate of alumina (neutral alum) entirely deprived of iron. The principal agent in this mode of bleaching is the oxalic acid, the power of which over vegetable colouring matter is well known; the sulphate of alumina has no bleaching power of its own, but it forms with the colouring matter of the wood an almost colourless lake, which has the effect of increasing the bridliancy of the pulp. Chlorine, chloride of lime and any other mineral acids are decidedly injurious in the bleaching of all matters of this kind and always leave a more or less deep yellow tinge.

Naphthaline Colours.—The discovery of fuchsine, and other colours derived from aniline, first caused the existence of very rich sources of colouring matters to be predicted in mineral oils and carburet of hydrogen in general. Therefore, since that period, chemists have devoted themselves to laborious researches in the same direction, in order to find new dyeing products. The method which M. Clavel has adopted was suggested by the study of the circumstances which have since been explained respecting the formation of fuchsine. It is now, in fact, known that commercial aniline is a mixture of aniline and toluidine, and M. Hofmann has proved that it is a mixture of these two bases that produces the brilliant colour. Guided by the examination of these facts, M. Clavel has not sought in naphthylamine for a colouring matter by itself, but one likely to produce the colour by a mixture with another base, like naphthylamine, which has served to produce it, or with any other isomeric substance. The new colouring matter, then, is obtained by the direct oxidation of a product isomeric with naphthylamine, which is procured by distilling crude naphthylamine, produced by the reduction of nitro-naphthaline, and taking the products of higher distillation to mix with the naphthylamine. The dye obtained differs entirely from the colours extracted up to the present time from naphthylamine. We will describe, in a few words, the mode of operation:—The naphthaline being first treated with nitric acid of 1·33°, the resulting nitro-naphthaline is washed, and reduced, either by iron and acetic acid, or zinc and hydrochloric acid, or any other analogous means, so as to obtain a sufficient reduction; this reduction being made, distillation is proceeded with. In the first place, naphthylamine passes; the condensation is then easier; the fire is increased, and it is then that the second body, discovered by M. Clavel, presents itself. This body constitutes the generating matter; it is treated at 120° with 50 per cent of very dry nitrate of mercury; a quantity of naphthylamine, equal to the quantity of the body used, is then added, and left in contact for about a quarter of an hour; the mixture is then treated with boiling water containing a vegetable acid; the colouring matter is dissolved, and filtered to separate the crude matters. The solution thus obtained may be treated according to the ordinary methods, for instance, by means of a salt, the colouring matter will be separated from it; this dissolved in alcohol gives a red colour of a magnificent tone, finer and more solid than the colours now extracted from naphthaline and naphthylamine; it presents by itself on the threads or tissues of silk, tints with brilliant reflection, warmer and of a clear effect. Hitherto the nature of the body discovered has not yet been specified by the author; he is waiting to give the analysis and chemical composition of it; but we can already give the principal characters of the new product. This body, which passes at the higher distillation, distils at a temperature of about 300°; its vapours form, in condensing, a deposit which rapidly becomes brown on exposure to the air. In a state of purity it is solid below 15°; it has then a viscous appearance, similar to the consistence of butter; it becomes more liquid at a higher temperature.—*Moniteur Scientifique.*

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS *give notice that in accordance with a suggestion of* MR. CROOKES, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* MR. CROOKES *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

*** *We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies,* Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the CHEMICAL NEWS, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

W.—The treatise mentioned by you on water analysis is excellent; you can, if so inclined, purchase from Messrs. Griffin all the apparatus and test liquids, ready made, adapted for use according to the directions of this book. As to sewage, there does not exist any special treatise on the analysis thereof, but in Fresenius's and Noad's works on "Quantitative Analysis" you will find every information you may require to enable you to analyse what you desire. Your letter will appear next week.

A Subscriber since January.—Mr. Little's letter "On the Estimation of Phosphates," in No. 434 of the CHEMICAL NEWS (*Am. Repr., May, 1868, page* 246), will probably give the information you require.

W. J. Morgan.—You will find a good chapter on the use of the spectroscope in the last edition of Fresenius's "Quantitative Analysis." A book on the subject will shortly be published by Macmillan.

Tincture.—If you intend to sell it as a proprietary medicine it will certainly require the medicine stamp. By sending particulars to the Board of Inland Revenue, Somerset House, you will receive full information on the subject.

E. K.—The description of the apparatus is received, with thanks; we are always glad to have notes of novelties or improved apparatus. The yellow, red, and green lines, shown by sodium, lithium, and thallium in the spectrum microscope are true lines, not bands. A band is not generally sharp at the edges, and is wider than the image of the slit. Your difficulty is probably more apparent than real, still we should like to see Father Secchi's answer to your question. The description of the battery was too complicated, and required too many cuts to enable it to be given in our pages; it was, however, of no use to one or two correspondents. Hofmann's report on the aniline colours at the Paris Exhibition is given as a supplement to the English edition of Reimann's "Aniline." The book can be obtained at our office.

E. C. C. S.—The paper as last sent will be inserted next week; the second paper will follow.

Paper's questions cannot be answered without going into details, which must be fully discussed. A letter is waiting for him at our office.

M. P. Muir.—The process was fully described at the Chemical Society last session.

J. Lee, who enquires about aniline black, is referred to our Notes and Queries column.

H. K. L.—It would be obviously unfair to admit in these columns queries which are only of personal interest. These should properly be inserted in our advertising columns.

Jamie.—The book can be supplied on application to our publisher.

B.—The question was answered in our last number.

E. K.—We know of no sources of experiments on the aniline dyes than the lectures which have, from time to time, appeared on the subject in our pages.

Communications have been received from Dr. H. Lawson; E. Kernan; J. Emerson Reynolds; R. Weaver; H. Hudson; W. L. Spiers; F. M. Jenning; Messrs. Townsend and Adams; Hugh Munro; Jones, Bros., and Co.; R. Spice; G. H. Ogston; E. W. Streeter; L. Demuth and Co.; J. Simpson; S. and E. Collier; Morgan and Davies; J. Mosley (with enclosure); C. Tomlinson, F.R.S.; G. F. Rodwell; Street, Bros.; J. Browning; A. Norman Tate (with enclosure); J. Denman (with enclosure); J. Bagueley; A. B. Fleming and Co.; Dr. T. Wood; J. Coupland (with enclosure); S. E. Phillips (with enclosure); P. Squire (with enclosure); Longmans and Co.; W. A. Murray; H. Stephenson; R. Mallet, F.R.S.; H. Rey; Dr. Röhrig; Dr. Goedicke; E. C. C. Sanford (with enclosure); P. Finnegan; G. Preece; H. Crossley; F. Ritchie and Sons (with enclosure); J. Lee; P. M. Muir; W. Longworth; C. R. C. Tichborne; Professor Gunning (Amsterdam); F. Smith; W. H. Hancock; W. H Perkin, F.R.S.; F. Field, F.R.S.; H. S. Ellis; J. C. Bowring; R. Kirwan; Dr. Lawson; T. Hill; M. Fletcher; E. Britten; Messrs. Townsend and Adams; J. Mercer; W. A. Todd; J. Davis; Griffiths, Bettison, and Co.; A. Jones (with enclosure); E. G. Tosh; W. Wyles; D. Brown; J. Kempster; W. Baxter; J. J. Griffin and Sons; J. A. R. Newlands; W. F. K. Stock; J. Bayne; W. Blench; C. G. Williams, F.R.S.; Moy Thomas; R. G. Bennett; F. Braby; S. D. Tillman; W. C. Roberts; J. Bethell; C. W. Heaton; Dr. R. Angus Smith, F.R.S.; E. Kernan; T. A. Orme; M. A. Baines; W. H. Perkin, F.R.S.; J. H. Cheshire; W. A. Murray; D. Brown; J. Kempster, C. S. Woodrowe; T. Huson; E. H. Moss; S. Mellor; W. Baxter; T. A. Pooley; F. Stevenson; J. Yates; W. Wyles; J. Millar; Green and Co.; Eicholtz and Co.; Todd and Son; Calvert and Co. (with enclosure); G. A. Keyworth; E. Meldrum; E. K. Muspratt; A. Warner; W. Huggon; B. Winstone; and White and Co.

Books Received.—"Laboratory Teaching; or, Progressive Exercises in Practical Chemistry." By Prof. C. L. Bloxam. London: Churchill and Sons. "Pure Wine, and how to know it," by J. L. Denman. "Cyclopædic Science;" simplified by J. H. Pepper, F.C.S., Professor of Chemistry at the Royal Polytechnic Institution; with 600 illustrations. London: Frederick Warne and Co. New York: Scribner, Welford, and Co. "The American Journal of Obstetrics and Diseases of Women and Children;" May, 1868, and May, 1869. Edited by E. Noeggerath, M.D., and B. F. Dawson, M.D. New York: W. A. Townsend and Adams. London: Sampson Low and Marston. Paris: J. B. Baillière.

AMERICAN SUPPLEMENT.

New York, July, 1869.

Croton Water—Its Quality.

WE are led to make the following extracts from our report to the Metropolitan Board of Health, by the articles which appear so frequently of late in the daily papers, in which gross misstatements are made both with regard to the quantity as well as the quality of the Croton supply:—

"For the past two summers the water has been analysed twice a month, with the following results: One U. S. gallon of 231 cubic inches contained:

	Summer of 1867. 39 Analyses.	Summer of 1868. 12 Analyses.
Inorganic Matter,	3.90 grains.	3.31 grains.
Organic and Volatile,	0.66 "	1.14 "
Total	4.56	4.45
Oxygen required to oxidize the organic matter: Permanganate of Potassa test,	0.1055 grains.	0.098 grains.

"A careful inspection was made of the sources of the Croton water supply, and 18 samples were collected at the more important points, representing all the larger brooks and streams." Analysis showed in one U. S. gallon:

	Most Impure.	Least Impure.	Average of the 18 samples.
Inorganic matter,	5.73 grains.	1.20 grains.	3.72 grains.
Organic & volatile,	0.64 "	1.07 "	0.63 "
Total	6.37	2.27	4.35
Oxygen required to oxidize the organic matter,	0.0787 "	0.2519 "	0.1055 "

"The difference in purity shown by these waters was not unexpected, as some of the brooks rise high up among the hills, and pour down over pebbly beds to

TABLE SHOWING THE PURITY OF CROTON WATER AS COMPARED WITH THE WATERS OF OTHER CITIES.

RESULTS CALCULATED FOR 100,000 PARTS OF WATER.

Cities Supplied.	Source of Water.	Inorganic Matter.	Organic and Volatile Matter.	Total Solids.
New York	Croton: Average for three months, 1868 (C. F. Chandler)	5.66	1.97	7.63
New York	Croton: Average for thirteen weeks, 1867 (C. F. Chandler)	6.72	1.12	7.84
New York	Well west of Central Park (No. 1), (C. F. Chandler)	66.80	7.80	74.60
New York	Well west of Central Park (No. 2), (C. F. Chandler)	69 10	3.40	72.50
Brooklyn	Ridgewood: Average for three months, 1868 (C. F. Chandler)	3.91	1.43	5.34
Boston	Cochituate (E. N. Horsford)	4.12	1.22	5.34
Philadelphia	Fairmount, Schuylkill (E. N. Horsford)	3.95	2.06	6.01
Philadelphia	Delaware (H. Wurtz)	4.97	1.08	6.05
Albany	Hydrant (E. N. Horsford)	14.52	3.96	18.48
Troy	Hydrant (W. Elderhorst)	10.44	2.30	12.74
Utica	Hydrant (C. F. Chandler)	9.43	1.64	11.07
Syracuse	New Reservoir (C. F. Chandler)	20.81	3.08	23.89
Cleveland	Lake Erie (J. L. Cassels)	8.13	2.62	10.75
Chicago	Lake Michigan (J. V. Q. Blaney)	9.63	1.81	11.44
Rochester	Genesee River (C. F. Chandler)	20.62	2.12	22.74
Schenectady	State Street Well (C. F. Chandler)	80.38	4.00	84.38
Newark, Jersey City, Hoboken, Hudson City	Passaic River (E. N. Horsford)	7.85	4.90	12.75
Trenton	Delaware River (H. Wurtz)	5.02	0 95	5.97
London	Thames: Grand Junction Co. (Dr. H. Letheby)	26.67	1.43	28.10
London	Thames: West Middlesex Co. (Dr. H. Letheby)	22.60	1.21	23 81
London	Thames: Southwark and Vauxhall Co. (Dr. H. Letheby)	25.78	1.43	27.21
London	Thames: Lambeth Co. (Dr. H. Letheby)	25.36	1.78	27.14
London	Thames: Kent Co. (Dr. H. Letheby)	38.21	1.07	39.28
London	New River Co. (Dr. H. Letheby)	23.93	0.35	24.28
London	East London Co. (Dr. H. Letheby)	26.71	0.71	27.42
London	Well, Leadenhall street (Dr. H. Letheby)	154.98	16.44	171.42
Dublin	Lough Vartry, new supply (Apjohn and oths.)	3.04	2.30	5.34
Paris	Seine, above the city (Bussey, Wurtz and Ville)	13.43	1.70	15.13
Paris	Reservoir, Montmartre (Bussey, Wurtz and Ville)	17.73	3.50	21.23
Paris	Reservoir, Passey (Bussey, Wurtz and Ville)	19.81	3.21	23.01
Stockholm	Maelar Lake (Alex. Mueller)	47.00	7.00	54 00
Stockholm	Hagar Palace (Dr. Bahr)	27.88	3.26	31.14
Stockholm	Well, Hanwerkerstrasse (Alex. Mueller)	389.00	23.00	410.00
Amsterdam	River Vecht (V. Baumhauer & Van Moorsel)	24.78	3.66	28.44
Amsterdam	Deep well at the Keisersgracht (V. Baumhauer and Van Moorsel)	110.69	7.51	118.10
Amsterdam	Artesian Well at Bikkerseiland (V. Baumhauer and Van Moorsel)	106.89	2,31	109.20

the main stream, while others have their origin in swamps, and flow sluggishly along beneath the shadows of the swamp maple and the sumach."

"All are, however, remarkably pure."

"The foregoing table shows the comparative quality of the water used in several large cities in the United States and Europe. It will be seen that the Croton compares favorably with the best waters on the list. That the table might be more generally available for comparison, the results are given in parts of impurity in 100,000 of water.

"The results of these investigations, with regard to the quality of the water supply of New York, are eminently satisfactory, as the purity of the water is fully established. No one who has examined the district of 338 square miles which supplies the Croton River will be surprised at this result. Mountains and hills of azoic gneiss receive the rainfall, which is quickly absorbed and filtered by the pure silicious sands and gravels, to gush out in numberless springs, feeding the brooks which bear the sparkling waters to the ponds which serve as natural storage reservoirs. From these flow the large streams, which, by uniting, form the Croton River. This is finally expanded, by the dam at the head of the aqueduct, into a broad, deep lake, the *fountain reservoir*, in which the quiet waters deposit the finer sediments, and thus undergo a final purification before they are admitted to the aqueduct.

"Nowhere along the streams can anything be found which can render the waters impure. Rugged rocks or bright green pastures generally border them. A few factories have been located at points where the water-power was available, but a careful examination failed to reveal any pollution of the water by them.

"We were deeply impressed with the eminently satisfactory condition of everything connected with the Croton water supply. The condition of the lake and streams, the admirable site selected for the new reservoir, the care to prevent pollution of the waters, everything we saw satisfied us that the officers in charge fully appreciate the vital importance of guarding this great element of health, and of supplying it to the million of people residing on New York Island with its native purity undiminished."

The Croton water is now distributed from three reservoirs, all of which have been full during the entire season. Their capacity is as follows:

Fifth Avenue Reservoir	20 million gallons.
Central Park old Reservoir...	38 " "
Central Park new Reservoir..	1,000 " "

The department now furnishes to the city 65 million gallons of water per day, and the supply is more than equal to this enormous demand. If it were desirable 80 or 90 million gallons could be furnished.

To provide for dry seasons a dam is now in process of erection at Boyd's Corner, by which a fine natural basin will be changed to a great storage reservoir capable of holding 3,000 million gallons of water, which would carry the city through the driest season ever experienced.

Many other similar natural basins exist in the valley of the Croton and its tributaries, which by properly constructed dams can be made to retain the waters which fall during the winter months. There need be no fear for the future, therefore, as the 338 square miles of water-shed which supply the Croton are capable, with proper reservoirs, of furnishing to a city of many times the size of New York an abundant supply of water.

Both the quality and the quantity of the Croton water supply are therefore above reproach.

The Ballston Artesian Spring.

TWENTY years ago the mineral waters of Ballston Spa rivalled those of Saratoga Springs, in the same county, and drew large numbers of visitors to the village every year. The springs were, however, finally lost. In making improvements about them the flow of water was in some way interrupted, and they found other outlets or were choked up entirely.

It is doubtful whether these waters would ever again have attracted attention had not an enterprising person bored an artesian well, in the vain hope of "striking oil." This patient but ill-advised seeker after petroleum selected a spot on the bank of the Kayáderosseras Creek, and bored down through sand, clay, and hard pan, fifty-six feet, till he struck the solid rock. He tubed the well down to the rock with an iron tube six inches in diameter, and then continued the boring with a five-inch drill. For a considerable distance the drill passed through the Hudson River shale, then it penetrated the Trenton limestone, then the Calciferous sand-rock, and, probably, passed some distance into the Potsdam sandstone. At a depth of 571 feet a vein of mineral water burst into the well; but as oil was the object of the search, it was not heeded. Finally, our zealous borer was spared any further labor in this direction by the steel reamer, which became so firmly fastened in rock, at the depth of 651 feet, that it could not be extracted.

No oil making its appearance, and further progress in the well being out of the question, attention was turned to the mineral water, when it was found that the most remarkable water of the county had been discovered.

The following analysis of the water was made by C. F. Chandler and E. W. Root:

Chloride of Sodium	750·030	grains.
Chloride of Potassium	33·276	"
Bromide of Sodium	3·643	"
Iodide of Sodium	0·124	"
Fluoride of Calcium	trace.	"
Bicarbonate of Lithia	7·750	"
Bicarbonate of Soda	11·928	"
Bicarbonate of Magnesia	180·602	"
Bicarbonate of Lime	238·156	"
Bicarbonate of Strontia	0·867	"
Bicarbonate of Baryta	3·881	"
Bicarbonate of Iron	1·581	"
Sulphate of Potassa	0·520	"
Phosphate of Soda	0·050	"
Biborate of Soda	trace.	"
Alumina	0·077	"
Silica	0·761	"
Organic matter	trace.	"
Total per gallon (231 cubic in.)	1233·246	"
Carbonic acid gas	426·114	cub.in
Density	1·0159	
Temperature	52°	F.

This is double the quantity of mineral matter contained in the Congress, High Rock, Star, or any other spring in Saratoga county. The discovery of a porous stratum of rock filled with this highly saturated solution of mineral matter confirms completely the opinion

long held by geologists with regard to the origin of the springs of this neighborhood.

Beginning with the uppermost, the rocks of Saratoga county are: 1. The Hudson River and Utica shales and slates. 2. The Trenton limestone. 3. The Calciferous sand-rock, which is a silicious limestone. 4. The Potsdam sandstone; and 5. The Laurentian formation, of unknown thickness. The northern half of the county is occupied by the elevated ranges of Laurentian rocks: flanking these occur the Potsdam, Calciferous, and Trenton beds, which appear in succession in parallel bands through the central part of the county. These are covered in the southern half of the county by the Utica and Hudson River slates and shales.

The Laurentian rocks, consisting of highly crystalline gneiss, granite, and syenite, are almost impervious, while the overlying Potsdam sandstone is very porous, and capable of holding large quantities of water. In this rock the mineral springs of Saratoga probably have their origin. The surface waters of the Laurentian hills, flowing down over the exposed edges of the Potsdam beds, penetrate the porous sandstones, become saturated with mineral matter, partly derived, perhaps, from the limestones above, and are forced to the surface at a lower level by hydrostatic pressure. The valley in which the springs all occur indicates the line of a fault or fracture in the rocky crust, the strata on the west side of which are hundreds of feet above the corresponding strata on the east.

The mineral waters, probably, underlie the southern half of the entire county, many hundred feet below the surface; the accident of the fault determining their appearance as springs in the valley of Saratoga Springs, where, by virtue of the greater elevation of their distant source or the pressure of the carbonic acid gas set free by chemical changes, they reach the surface through crevices in the rocks produced by the fracture.

As it flows from the spring the water is clear and sparkling, and is highly charged with gas. Down in the earth, where the water is under pressure, it is overcharged with gas, and the removal of this pressure, as the water comes to the surface, causes, as previously remarked, an escape of the excess. The flow of gas is somewhat intermittent; for, while the escape of bubbles is constant, there occurs every few minutes a burst of gas which causes the water in the tube to foam up to a considerable height.

The gases evolved are carbonic acid and light carburetted hydrogen or marsh gas.

The success of this well has induced others to make similar borings in search of water, and other wells are now in process of boring. Undoubtedly they will all, if carried to a sufficient depth into the Potsdam sandstone, reach the source from which the natural springs are supplied, and the concentration of the water will increase with the depth attained.

Wollongong Cannel Coal.

In the Wollongong District, N. S. Wales, and under the Kembla Mountains, is a series of bituminous beds containing cannel coals, somewhat resembling the Boghead coal of Torbane Hill, Scotland, but much less earthy. This coal is amazingly rich in oil and gas. It was tested at the experimental works of the Manhattan Gas Light Co., of New York, by Professors Silliman and Wurtz, and found to yield by the usual process of gas-making 6·12 cubic feet of gas per pound, having an illuminating power of 133 candles. Ordinary gas coals yield from 4½ to 5 cubic feet of gas per pound, of an illuminating power of from 12 to 18 candles.

These results greatly surpass those obtained from the Boghead and Albert coals, which have till now stood at the head of all gas-producing materials.

An analysis by the same chemists gave

Volatile Matter	82·50
Fixed Carbon	6·50
Ash	11·00
	100·00
The Specific Gravity is	1·049

Mr. Young, of Glasgow, one of the earliest pioneers in the manufacture of coal and shale oils, subjected a sample of the Wollongong coal to distillation, and obtained from one ton of 2,240 pounds 152 gallons of crude oil, sp. gr. 0·860, which he divided as follows:

Light Naphtha, sp. gr. 0·730	8 galls.
Burning Oil, " 0·815	72 "
Lubricating Oil, " 0·890	33 "
Paraffine, 49 pounds	5 "
Loss, ash, &c.	32 "
	150 "

With this cannel coal occurs another variety of cannel nearer the Boghead in character. A sample of this examined by the editor a year or two since, which was known then as "Australian shale," yielded

Gases	21·11
Water	3·33
Crude Oil	35·08
Fixed Carbon	26·48
Ash	14·00
	100·00
The Specific Gravity is	1·106

The crude oil had a specific gravity of 0·876, or 31° Beaumé, and measured 96·8 gallons per ton of 2,000 lbs.

Dangerous Kerosene.

We do not mean to allow a number of this journal to go to press without a paragraph calling the attention of our readers to this important subject. The apathy manifested by our law-makers is to us incomprehensible. Day after day we see accounts of horrible deaths from accidents: sometimes the lamp explodes, sometimes it is overturned; sometimes a fire is kindled with a little oil from the can; in numerous ways the fatality occurs; but the cause is always the same—*bad oil*. It has been our duty to examine the kerosene retailed in New York, and although we have purchased and examined upwards of 100 samples, we have not yet found a single sample of safe oil, oil which conforms to the regular legal standard—

"1. That it shall not take fire or burn at a temperature below 110 deg. Fah.

"2. That it shall not evolve an explosive vapor below 100 deg. Fah."

—whi e about twelve per cent. of the specimens are pure benzine, the most volatile and dangerous product of petroleum. State Prison for life should be the penalty for selling benzine for lamps, especially if it is sold under such names as "Safety Oil," "Liquid Gas," "Aurora Oil," &c., by which its real character is concealed.

These most dangerous oils can be recognized at once by applying a lighted match to a small quantity contained in a saucer. Every oil that can be lighted with a match should be condemned at once, as only *the most dangerous* will take fire at ordinary temperatures. The heart-rending, sickening sights we have seen at some of the hospitals in New York during the past winter—poor creatures, generally women and children, who were suffering the agonies of a lingering death from kerosene accidents—drive us almost wild whenever we think of them. We must have a crusade against the retailers of *dangerous kerosene.*

Carbolic Acid or Coal Tar Creosote.

Dr. Edward R. Squibb, of Brooklyn, read an interesting paper on this subject before the American Pharmaceutical Association at its last meeting, which appears in part in the *Am. Jour. of Pharm.* for May. Dr. Squibb separated from the crude carbolic acid the pure or nearly pure phenol or carbolic acid, and cresol or cresylic acid, and tested their comparative value as "azymotics," finding that the latter is more than twice as active as the former. This is a very important fact to establish, as it is usual, in selecting carbolic acid for disinfecting purposes, to suppose that the purer the acid, the better. In England much of the acid is almost chemically pure, appearing as a beautiful white solid. He advises, therefore, the use of the mixed acids, freed as much as possible from the inert hydrocarbons, under the name of coal tar creosote. His experiments are so well devised, and the information contained in the paper so important, that we refer the reader to the original article.

NEW PUBLICATIONS.

The Manufacturer and Builder,
A handsome quarto of 32 pages, is published monthly by Western & Co. of New York. It is printed on excellent paper, illustrated by numerous engravings, and is devoted to the mechanical and chemical arts. It is very ably edited, and although but six numbers have as yet appeared, its success is already assured. It is a journal which every enterprising mechanic should read. The editor, Mr. L. H. Mitchell, is specially qualified to conduct such a journal, having graduated at Harvard, studied Civil Engineering at Union, Assaying at Columbia, and Mining Engineering at Freiberg. The journal is also largely indebted to the able pens of Dr. P. H. Van der Weyde and Dr. Adolph Ott for valuable articles on chemical subjects.

The American Journal of Science and Arts, for May, 1869.
The articles in this number specially interesting to chemists are: 1. On the Atomic Volumes of the Elements. By F. W. Clark. 2. On some Minerals from Newlin Township, in Chester Co., Pa. By S. P. Sharples. 3. On the Washing of Precipitates. By Prof. R. Bunsen. 4. On the Origin of the Phosphatic Formation. By C. U. Sheppard, sr. 5. On some Derivatives of Trichlormethyl-sulpho-chloride. By O. Loew. 6. On the Occurrence and Composition of the Nodular Phosphates of South Carolina. By C. U. Sheppard, jr. 7. Process for determining the Carbon chemically combined with Iron. By Prof. Eggertz. 8. The Cohahuila Meteoric Irons of 1863. By J. Lawrence Smith. 9. Atomic Ratios. By Josiah P. Cooke, jr. 10. Notices of Papers in Physiological Chemistry. By Geo. F. Barker.

Final Report on the Geology of New Jersey. By Geo. H. Cook, State Geologist. Newark, 1868. 8vo, 900 pages, with engravings and maps.
This work contains a large amount of valuable information, much of it necessarily of a purely geological character. Considerable space is devoted, however, to the Iron Ores, Zinc Ores, Fertilizing Marls or Green Sands, Clays, &c. We agree fully with the reviewer of this report in Silliman's Journal, who says "we are pleased to see a recognition of the well established fact that soil analyses are of but little benefit to farmers."

BREVITIES.

Prof. H. Dussauce, the chemist in charge of the laboratory of Tilden & Co., and editor of *The Industrial Chemist*, published in New York and Boston, died suddenly at his residence in New Lebanon, on the evening of June 21st.

Dr. R. A. Fisher, Professor of Chemistry at the University of California, sailed last week for Europe, to purchase apparatus, reagents, &c., for the equipment of his laboratories.

The incorporators of the National Institute of Letters, Arts and Sciences, met in New York, May 25th, and formally accepted the charter granted them by the Legislature of New York.

President Barnard, of the Columbia College School of Mines, as well as Prof. Egleston, Prof. Rood, and Dr. Schweitzer, will spend the summer in Europe.

Free Bathing Places for All.—We cordially give our support to the movement now on foot to secure free public baths. Nothing will more effectually improve the health, and even the morals, of the community.

The New York College of Pharmacy.—During the coming winter the lecturers will be W. D. F. Day, M.D., on "Materia Medica and Botany;" E. R. Squibb, M.D., on "Practical Pharmacy;" C. F. Chandler, Ph.D., on "Chemistry."

Oscar Loew, Chemical Assistant in the Chemical Department of the College of the City of New York, publishes an article in the May number of *Silliman's Journal* on "Some Derivatives of Trichlormethyl-sulphon-chlorid. $(C Cl_3) SO_2Cl$."

Dr. J. S. Newberry, Professor of Geology at the Columbia College School of Mines, has recently been appointed State Geologist for Ohio, and has already gone into the field for the summer, taking with him a corps of assistants and several students from the School of Mines.

A Curious Coincidence.—At about the time that Mr. H. C. Sorby exhibited, at the March soirée of the Royal Society of Great Britain, the indications of a new metal in zircons, O. Loew and H. Endermann, of New York, mentioned their entirely different reasons for suspecting the existence of a new metal in zircons, at a meeting of the Lyceum of Natural History.

Prof. S. W. Johnson's testimony in regard to the Earth Closet is worthy of candid consideration. Many a one who has read Victor Hugo's wonderful description of the sewers of Paris in "Les Miserables," has been deeply impressed with the vast amount of fertilizing wealth which is annually washed into the sea. What is true of Paris is true of every large city. The Earth Closet is of vast importance as regards the wealth of this country, and we are glad to see it receiving the attention of scientific men.—*The College Courant.*

The American Association.—The eighteenth meeting of the American Association for the Advancement of Science will be held at Salem, Mass., commencing on Wednesday, August 18th. On the afternoon of the first day of the meeting, the Association will be invited to participate in the dedication of the Museum of the Peabody Academy of Science, followed by a levee in the evening. For circulars containing full particulars of the meeting, address F. W. Putnam, Local Secretary, Salem, Mass.

Prof. Charles W. Eliot has accepted the position of President of Harvard College. He is decidedly the youngest president ever called to this institution. As he was Professor of Analytical Chemistry and Metallurgy at the Technological Institute of Boston, his election is a marked innovation on the old system of selecting college presidents from the clergy only.

Bunsen's New Filtering Apparatus, which was described and figured in the Chemical News (Am. Repr.) for June, p. 282, has been introduced into the laboratory of the Sheffield Scientific School at New Haven. Five of the water air-pumps have been erected there at a very moderate expense. They work admirably, and enable the analyst to wash his alumina, sesquioxide of iron, and other gelatinous precipitates in a very short time. Some one remarked that this invention of Bunsen's would give at least 1000 years of additional effective time to the present generation of chemists. We think Prof. Johnson has improved a little on Bunsen's apparatus, at least in simplicity of construction.

The American Institute.—The American Institute will give an exposition of agricultural, mechanical, artistic, and other productions, in the city of New York, commencing on the 8th of September next. The large building known as the Empire Rink, on the corner of Sixty-third Street and Third Avenue, has been engaged for the exhibition, and will be open for the reception of goods on and after Sept. 1st. Articles should be directed to "The American Institute Exhibition, care of John W. Chambers, Secretary, corner of Third Avenue and Sixty-third Street, New York." The railroads, steamboats, and express companies have agreed to return freight free, all articles exhibited, the freight on which to New York shall have been paid, provided they have not changed ownership, and are returned before Nov. 15th. The following are the departments of the exhibition: 1. Fine Arts and Education. 2. Department of the Dwelling. 3. Dress and Handicraft. 4. Chemistry and Mineralogy. 5. Engines and Machinery. 6. Intercommunication. 7. Agriculture and Horticulture.

Sad Accident to Prof. Bunsen at Heidelberg.—Prof. Bunsen recently met with a most serious accident, which threatens to deprive him of the use of his eye. He lost one eye many years ago in experimenting on kakodyl and its compounds, but has been able to accomplish an immense amount of work with the other. He is now in danger of becoming completely blind. A quantity of the rare metal rhodium, which had been precipitated by electricity, exploded spontaneously at his touch. His chief anxiety now is that he may regain his sight to enable him to find out why the rhodium exploded. The chemist who has given us the Bunsen's Battery, the Bunsen's Burner, the Bunsen's Photometer, the Spectroscope, Spectrum Analysis, Cæsium, and Rubidium, deserves our warmest sympathy.

THE CHEMICAL NEWS.
Vol. V. No. 2. American Reprint.

RESEARCHES ON TURACINE,

AN ANIMAL PIGMENT CONTAINING COPPER.*

BY A. H. CHURCH, M.A., OXON.,

PROFESSOR OF CHEMISTRY IN THE ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

From four species of *Touraco*, or plantain-eater, the author has extracted a remarkable red pigment. It occurs in about fifteen of the primary and secondary pinion feathers of the birds in question, and may be extracted by a dilute alkaline solution, and re-precipitated without change by an acid. It is distinguished from all other natural pigments yet isolated, by the presence of 5·9 per cent of copper, which cannot be removed without the destruction of the colouring matter itself. The author proposes the name *turacine* for this pigment. The spectrum of turacine shows two black absorption bands, similar to those of scarlet cruorine; turacine, however, differs from cruorine in many particulars. It exhibits great constancy of composition, even when derived from different genera and species of plantain-eater; as, for example, the *Musophaga violacea*, the *Corythaix albo-cristata*, and the *C. porphyreolopha*.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.†

BY DR. E. FLEISCHER, OF DRESDEN.

ON THE EMPLOYMENT OF CONSTANT FACTORS IN THE CALCULATION OF INDIRECT ANALYSES.

In the calculation of indirect analyses, it is of the highest importance that a factor should be found which, when multiplied by the weight of one of the substances to be estimated, gives the weight of the other. For the determination of this factor, the rule is to form two equations, expressing the relations of the atomic weights of the substances in question from different points of view. These constant factors may, however, be obtained more quickly and simply, without the assistance of equations, by the following method, which, besides facilitating calculation, is capable of employment by persons not sufficiently versed in mathematics to solve common equations.

Suppose two substances, X and Y, each of which is chemically combined with an acid or base: these two salts may be expressed by the common formula (X + C) + (Y + C); and consider the collective weight of these two compounds, which is found, by directly weighing, as equal to G. If we now assume that base or acid (to whichever the substances X and Y may be combined) is determined by analysis, and that this amount is represented by the weight C, X and Y will be the two substances to be found by calculation, and of which nothing further than their atomic weight is known.

Now, proceed as follows. First calculate what the weight of this salt would be if C were combined with the body X, having a smaller atomic weight than Y. Deduct this weight, which I will call g, from the collective weight of the two salts, which was G, and multiply the remainder by the constant factor S; the product will then be either $(G-g)\,S = Y$, or equal to the weight of the one substance, possessing the highest atomic weight which was to be indirectly found. The weight of X is obtained quite simply by deducting the sum Y + C from the collective weight G.

The determination of the constant factor ϕ is easily effected in the following manner. Suppose the two salts X + C and Y + C to be mixed together in the ratio of equal atomic weights, and add their atomic weights together. From this amount subtract the doubled atomic weight of the salt X + C (supposing X to be larger than Y), and divide the remainder by the atomic weight of Y; the quotient will then be the required constant factor for the case in point. Two examples in figures may, perhaps, render this mode of calculation more clear. The amount of K and Na contained in a weighed mixture of chloride of potassium and chloride of sodium is to be determined, the collective amount of chlorine having been ascertained in the volumetric mode, by means of a solution of standard silver; the required factor ϕ is then found as follows:—

	1 equiv.	K Cl = 74·6
	+1 "	Na Cl = 58·5
Hence—1 equiv. KCl + 1 equiv.		Na Cl = 133·1
When deducting—	2 "	Na Cl = 117·0
A remainder is left of—		16·1

This remainder of 16·1, divided into the atomic weight of K = 39·1, gives, as a constant factor,—

$$\phi = \frac{39{\cdot}1}{16{\cdot}1} = 2{\cdot}4285.$$

Let us suppose that the united weights of chloride of potassium and chloride of sodium amount together, in a given case, to 1·916 grms., while the total amount of chlorine found weighs, when calculated as chloride of sodium, 1·755, grms. The differencebetween these two weights will then be—

1·916 grms.
−1·755 "
0·161

This remainder of 0·161 grms. gives, when multiplied by the constant factor 2·4285, the amount of potassium 0·390988 grms., or, in round numbers, 0·391 grms. of potassium. This weight, and the ascertained total of chlorine, *viz.*, 1·065 grms., deducted from the weight of both salts = 1·916 grms., gives 1·916 − 1·065 − 0·391 = 0·460 grms. of sodium.*

Let us take as our second example the estimation of chlorine, bromine, and iodine, in combination, by a solution of nitrate of silver. Several simple methods of effecting this are known. Among them is one I would especially recommend, in which the iodine is separately estimated, by distillation with sesquichloride of iron, or by precipitation as subiodide of copper; while the amount of silver required for precipitating the three silver compounds is determined by subsequently ascertaining the silver contained in the filtrate, and deducting it from the measured testing solution employed. This method is preferable, because one weighing of the chloride, bromide, and iodide, of silver, with the addition of the iodine already found, and the ascertained quantity of silver, suffices to calculate the weight of the three halogens where several weighings would be required.

I have intentionally chosen the most complicated

* Abstract of a paper read before the Royal Society, May 27th, 1869.
† Communicated by the Author.

* The potassium and sodium contained in the mixed salts are therefore found by calculation.

[English Edition, Vol. XIX., No. 496, page 265.]

method of calculation, in which the directions are as follows:—Weigh the amount of precipitated chloride, iodide, and bromide of silver, then transform all the chloride into bromide of silver by a lengthy digestion with bromide of potassium (which must be quite free from iodine), weigh the precipitate, which will now consist of only bromide and iodide of silver, and digest the weighed precipitate with iodide of potassium, whereby all the bromide of silver is changed into iodide, and the precipitate, which is to be again weighed, will contain merely silver and iodine.

It will be perceived that the last weighing of the iodide of silver only serves to ascertain the total amount of silver which is contained in all the precipitates: if this be known, the transformation of the bromiodide of silver into iodide of silver by iodide of potassium can, of course, be omitted, and also the third weighing. Thus we have here determined the amount of silver which was combined with the three halogens, chlorine, bromine, and iodine. The same amount of silver was also contained in the precipitate of bromiodide of silver. We will now calculate the constant factor for these two combinations in the following way:—

	1 equiv. AgBr=	188
+	1 " AgI = ...	235
	1 equiv. AgBr+1 equiv. AgI=	423
Thence deducting—	2 " AgBr=	376
Gives as remainder—		47

If we divide 127, the atomic weight of iodine, by the remainder, 47, the constant factor between bromide and iodide of silver will be—

$$\phi = \frac{127}{47} = 2{\cdot}7021$$

The factor between chloride and bromide of silver, which is also required, is calculated in a similar manner—

AgCl = ...	143·5
AgBr = ...	188 0
AgCl + AgBr = ...	331·5
Hence— 2 AgCl=	287·0

And 80 Br, divided by the remainder, 44·5, gives—

$$\phi\ 1 = \frac{80{\cdot}0}{44{\cdot}5} = 1{\cdot}7977$$

as the factor between AgCl and AgBr.

Let us now suppose the weight of the third deposit to amount to 1·645 grms.; its proportion of silver (similar to that in the other deposits) will therefore amount to 0·756 grms.; and, supposing the weight of the iodide and bromide of silver (the second precipitate) to be 1·363 grms., the amount of iodine may be calculated as follows:—

The weight of AgI+AgBr was—	1·363 grms.
Thence deducting the amount of AgBr which corresponds to the weight of silver of 0·736 grms, namely—	=1·316
The remainder of—	0·047

multiplied by the factor ϕ for iodide and bromide of silver, 2·7021, gives—

0·047 × 2·7021=0·1269987 grms. of iodine.

Let us assume that the weight of the first precipitate of chloride, bromide, and iodide of silver amounts to 1·185 grms.; there will then remain, after deducting the amount of Ag corresponding to the iodine found,

	1·185 grms.
	—0·235 "
a remainder of—	0·950

which represents the collective weight of the chloride and bromide of silver.

Since, then, the collective weight of silver amounts to 1·756 grms., and that contained in the form of iodide of silver to 0·108 grms. (corresponding to 0·127 grms. of iodine), the weight of silver which was contained in the first deposit as AgCl and AgBr is 0·756—0·108=0·648 grm. This amount of silver, when considered as chloride of silver, gives 0·861 grm. AgCl; and this, subtracted from the weight of chloride and bromide of silver, gives—

0·950 grm.	AgClAgBr
0·861 "	AgCl
a remainder of— 0·089	

which, when multiplied by the factor between chloride and bromide of silver, ϕ=1·7977, gives—

0·089+1·8=0·160 grm. Br.

Lastly, if the collective weight of silver, together with that of the iodine and bromine, be deducted from the weight of the first precipitate of chloride, bromide, and iodide of silver, the weight of the chlorine will be 1·185—0·756—0·127—0·160=0·142 grms. The substance in question contains, therefore, about 1 equiv. of iodine, 2 of bromine, and 4 of chlorine.

Indirect analyses are always very good for rapid estimations without separation, but they are specially recommended when the known methods of separation are very minute, and therefore give rise to faults; or if the amount of one body be much larger than that of the other, which renders separation more difficult.

In the succeeding description of the estimation of baryta, strontia, and lime, the convenience of indirect analysis will be specially demonstrated; and it is hoped that the mode by calculation, above explained, and which is as simple as it is quick, will no longer be disregarded.

ON THE

METHODS OF DETERMINING

THE AMOUNT OF

PRECIPITATED OR REDUCED PHOSPHATES IN ARTIFICIAL MANURES.

BY JOHN HUGHES, F.C.S.

My attention has been directed to a communication from Mr. J. A. Chesshire (analytical chemist at the manure works of Messrs. Bradburn & Co., Wednesfield), published in a recent number of the Chemical News, in which a new method of estimating the amount of precipitated phosphates present in superphosphate and similar artificial manures is recommended, namely, that of boiling the portion insoluble in water for about half-an-hour with a solution of oxalate of ammonia, adding a few drops of oxalic acid.

I am surprised that any such process should have been recommended by a chemist, as it is an acknowledged fact that oxalate of ammonia, even in a cold solution, possesses the property of acting on insoluble phosphate of lime to an appreciable extent. Liebig has referred to this function of oxalate of ammonia when speaking of Peruvian guano, and has pointed out that

which is present in guano in a variable pro-
plays an important part in rendering the in-
hosphates to a certain extent soluble.
recently, Dr. Voelcker, in a paper "On the
f Increasing the Efficacy of Peruvian Guano"
d in the *Journal of the Agricultural Society*,
as described some interesting experiments
ove that oxalate of ammonia, which is always
even in best Peruvian guano, has the effect of
g the insoluble guano phosphates soluble. He
oreover, that this effect is greater when com-
y little water is mixed with guano, and the
ated solution of oxalate of ammonia thus pro-
allowed to react for several hours upon the
guano phosphates, than when much water is
nd the weak oxalate of ammonia solution is
off at once from the insoluble portion of the

ght be urged that the peculiar solubility of a
proportion of the phosphates in guano is pro-
e to the minute state of division in which they
ent in this material; I have, therefore, made
wing experiments with ground Cambridge
, a phosphatic mineral, which is particularly
d which, I need hardly mention, contains no
"reduced" or precipitated phosphates.
ty grains of coprolite were boiled for about
our with 4 ounces of a solution which contain-
ains oxalate of ammonia and 20 drops of oxalic
tion (strength, 1 in 30); the insoluble portion
n removed, and the phosphoric acid in the
etermined as pyrophosphate of magnesia, the
eing calculated as tribasic phosphate of lime.
d experiment was made, in which 20 grains of
of ammonia were added, instead of 10 grains.
olution (filtrate), in the

riment, contained phosphoric acid 3·48 per cent
qual to tribasic phosphate of lime 7·61) "
eriment, contained phosphoric acid 4·60 per cent
qual to tribasic phosphate of lime 10·05) "

might appear that free oxalic acid was the
l agent in rendering the coprolite phosphates
I made another experiment, in which oxalate
onia alone was employed.
ty grains of coprolite powder, 40 grains
of ammonia, and 4 ounces of water were di-
or half an hour, and the solution subsequently
n precisely the same way as before.
s experiment, I found in the filtrate—

phoric acid..... 5·38 per cent
l to tribasic phosphate of lime 11·75) "

l be seen that oxalate of ammonia acts with
able energy upon hard mineral phosphates;
tural, therefore, to suppose that it will render
the insoluble phosphates frequently present in
manures, in the shape of bone or bone-ash, to
r extent than it will hard mineral phosphates.
correspondent assumes that the plan of boil-
the insoluble portion of a manure with citric
the one now generally employed in estimating
ount of precipitated phosphates, but I do not
ry laboratory in which this practice prevails;
ents, the citric acid plan has been found im-
cable in Dr. Voelcker's laboratory, where I am
at present.
tly-precipitated phosphates, unquestionably,
e valuable than raw *mineral phosphates*; still it cannot be maintained that they are as efficacious and valuable as phosphates actually soluble in water.

As long as we cannot separate with accuracy precipitated from ordinary insoluble phosphates, it is certainly objectionable to introduce into analytical statements the term "precipitated" or "reduced" phosphates.

There is no difficulty in broadly distinguishing between phosphates actually soluble in water and phosphates insoluble in water; and it appears to me desirable to adhere to the present plan of guaranteeing the quality of mineral superphosphates—by stating the percentage of soluble and insoluble phosphates which they contain.

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.*

BY EDWARD C. C. STANFORD, F.C.S.

(Concluded from Am. Repr., July, 1869, page 18.)

Earth Carriage.

This subject has been already brought before you; but as its chemical aspect has not been treated, I shall briefly allude to it. Some misconception appears to have prevailed here as to the disinfecting power of dry earth and ashes; both are absorbents of moisture, and to this extent, and no further, are these disinfectants. This may be easily proved by filtering putrid urine through either of these media; it passes unchanged.

These materials are only, therefore, deodorisers when largely in excess of the fæcal matter to which they are added.

Thus to take dry clay, the best substance of the kind, it would require three and a half times as much as the excreta, or 17,500,000 cubic feet to be brought into the city, and 22,500,000 cubic feet to be taken out again; and the actual value of this product would be £208,333, or 2¼d. per cubic foot, or 6s. 7d. per ton. Its practical value would, however, be much less, because, on account of the expensive carriage, the value of a manure decreases in inverse geometrical proportion to its strength. It stands to reason, therefore, that if a dry vehicle is to be resorted to, it must be more economical to use some substance which increases, rather than diminishes, the agricultural value of the product, especially if less of it can be employed to do the same work. That substance which, while acting as a deodoriser, also absorbed the most water for a given weight, and added its value to the product, should, theoretically, be the best for this purpose. I find that, while perfectly dry clay only absorbs 45 per cent of water, dry seaweed char absorbs 147 per cent, and the former becomes a sludgy mud, while the latter can be easily removed.

The use of an absorbent of this kind would, therefore, reduce the amount of material to be brought into the city to less than one-third, or to an amount equal to the excreta to be removed; or 5,000,000 cubic feet brought in, and 10,000,000 cubic feet taken out, annually, the daily removal being 385 tons in, and 770 tons out. This is not more than the present daily removal of ashes, while there would be no greater nuisance, and the value, exclusive of the value of the charcoal, would be about 15s. per ton. Viewed in this light, the dry closet system presents strong claims to notice, and, in a sanitary sense, its arrangements are perfect.

* Read before the Glasgow Sewage Association, March 30th, 1869.

Air Carriage.

Carriage by atmospheric pressure possesses several advantages afforded by neither of the former systems, both of which add a large bulk of valueless but costly material to the excreta to be removed. Considering the great value, and easy application, of pneumatic pressure, it is remarkable that so little attention has been directed to it as a means of dealing with excreta; it has been entirely overlooked by those great authorities who have professed to look into all the bearings of this difficult question.

The principal effort in this direction is due to Captain Tiernur. I will briefly describe the main features of this proposition, referring to "The Sewage Question," by Krepp, for further details. Captain Tiernur proposes to place in houses a simple open-pan closet of a particular form, in connection with a vertical soil-pipe, and so shaped that the total excreta fall at once to the bottom of this pipe in the basement storey of the house, where it collects in a small syphon bend. The soil-pipe is made of earthen-ware, 14 to 16 inches in diameter, and is continued to the top of the house, where it is open to the air, and covered with a wind-guard for ventilation. The syphon bend and bottom of the pipe are of cast-iron narrowed from the soil-pipe to a 5-inch cast-iron pipe. This is continued to a central receiver, sunk in the public street. This reservoir has about 20 cubic feet capacity; and allowing 1 cubic foot to every thirty-six individuals, each serves about 700 persons and a number of houses. Each house has a so-called house-valve, which is accessible from the street, and closes the connection with the sewage reservoir. This reservoir may be placed in any central position in the public street, sunk under the ground, and surmounted by an ornamental lamp-post, within which the two communicating pipes are concealed. It is of a nearly spherical shape, or quite spherical top and bottom, with cylindrical sides. It receives the drain-pipes from a number of houses, collected in four main branches, which enter it with a slight bend at the top; the house pipes and main pipes are all about 5 inch bore, the former entering the latter horizontally at an angle of 30°, and a curve of 2 feet radius. The main pipes have a gentle downward inclination towards the reservoir, but enter it by a sudden bend upwards. There are two vertical pipes concealed within the lamp-post—one, the air-pipe, about 3 inch bore, fixed to the top of the reservoir; and the other the exit soil pipe, about 6 inch bore, continued nearly to the bottom of the reservoir.

The mode of filling and emptying these receivers is by a "locomotive engine and pneumatic tender," which is drawn by one horse, assisted by the steam power of the engine, to the several reservoirs during the night. The process is simple; the engine works a powerful air-pump, which is placed in connection with the reservoir and the tender; in about three minutes the gauge indicates a vacuum of about 10 lbs. to the square inch, or about 20 in. barometer pressure, and both are sufficiently exhausted. The several house-valves are then opened and closed consecutively, and the contents of the syphons instantly shot into the receiver by the downward pressure of air in the soil-pipe, the vertical ventilating shaft acting like a pea-shooter. When all the house-traps are discharged, the air-pipe of the receiver is disconnected, the exit soil-pipe connected with *the exhausted tender*, the contents thus transferred to *it, and the whole machine* is driven off to the next reservoir; the foul gas from the air-pump is blown into the engine furnace. The tenders have each 100 cubic feet capacity, 10 cubic feet of which is used as a water-tank to the engine. When full, these are taken to "decanting houses," where the contents are transferred to barrels. These barrels are 28 inches in diameter, 32 inches long, about 5 cubic feet capacity, and made of strong oak staves bound with iron hoops; they form the stores for the manure, and for its transport, and are to be sold direct to farmers. For applying the contents directly to the soil, which is Captain Tiernur's special object, he proposes plans of ingenious manure ploughs and meadow manurers, which support the barrel and empty its contents at once into the furrow, where it is covered over and kept at once from decomposition. During frost, he proposes keeping these barrels in store.

The method of collecting, and particularly of applying, the excreta in these barrels, seems to me a most unnecessary complication. Glasgow would collect at the rate of 2,740 barrels a day, and a month's frost would accumulate an explosive store of 82,000 barrels; while in the summer I fear the barrels could not be used fast enough to prevent decomposition. There is also this great objection to this method, which applies, also, to irrigation, that we are compelled to sell our manure constantly to get it off our hands, and by making the farmer take it when he does not want it, and cannot advantageously apply it, we are entirely at his mercy, and must accept his prices; but if we could store, make it into good manure, and sell it when he wants it, then, and not till then, can we expect to realise its value. If the other parts of this plan work well, a modification would make this feasible.

We have a material to deal with in chemical works which presents some analogy with that under consideration; it must be kept from the air, it cannot be handled; but it is nearly double the weight of the excreta, and very corrosive. Yet this is lifted, without any difficulty, to great heights, and carried long distances, with no trouble and little expense, by atmospheric pressure; and could not the excreta be dealt with in the same way? The drain-pipes from the houses should be led into iron reservoirs, the size and number of these to be determined; the total daily removal being only 13,700 cubic feet, twelve cylindrical boilers with egg-shaped ends, about 10′ × 10′, by 15 to 20 feet long, sunk vertically, would be sufficient for Glasgow. It might, however, be advisable to have smaller vessels in larger number; that is a matter of detail.

These reservoirs are all to be connected, by a small air-pipe, to one or more central pumping stations, where a powerful air-pump is fixed; each, also, to be furnished with an exit soil pipe, passing to the bottom, and continued up into a main pipe leading to one or two manure works situated some miles out of town.

This would, then, be the process of removal; at a fixed hour at night the air-pump would be set to exhaust a large iron reservoir at the pumping station, and communicating with the air pipes attached to the soil reservoirs. Two men for each district would then be sent round, and, opening the air-pipe valve, would place each receiver in connection with the exhausting pump, and then open, consecutively, the house-valves, by which means the soil-pipes would be nightly discharged, and the whole closet ventilated by a powerful blast of air. This is one operation. During the day, at a certain hour, the engine and air-pump would be reversed, and pump air into the air-vessel at the pumping station; the several soil reservoirs would then be placed in connec-

tion, and the contents lifted, by the atmospheric pressure, away to the manure works.

When we consider that a pressure of 50 lbs. on the square inch can be thus easily applied, there is merely the friction and some little weight to overcome; the plan seems quite practicable, and is, at any rate, worth a trial. The piping required would be an arterial system of small cast-iron piping; its cost, compared to sewers, would be little, and the cost for pumping must be insignificant, compared to that for lifting sewage in such enormous quantities.

The Abbey Mills pumping station has eight engines, 142 horse power each, or 11·36 horse power; and these lift 15,000 cubic feet a minute 36 feet high. We have only to lift 385 tons, or 13,700 cubic feet, and the whole day's produce of Glasgow may be contained in a tank 30 feet square and 16 feet deep. These pumps, therefore, would do our day's work in fifty-four seconds.

When engineers talk of intercepting sewers for our sewage, they mean immense culverts of brick, which leak in all directions, and are full of noxious gases, to carry off 137,000 tons of sewage a day, containing 385 tons, or 1-355th of excreta, and only 38½ tons, or 1-3550th of its weight, of solid excreta. My notion of a true intercepting sewer is a perfectly tight and cheap cast-iron pipe, which will really intercept this excreta, and deal with it alone. It is, to all intents and purposes, a fluid, and subject to all the laws of fluid pressure; to add 355 times its weight of water to *make it fluid*, is not only "carting coals to Newcastle," but it is paying very heavily for the pleasure of doing so.

Engineers should consider the possibility of removing, without nuisance, the excreta, as it is, from where it is to where it should be; because, if it can be so delivered, the further disposal of it can be safely left to chemists, who may, then, be fairly asked to turn it to account. We have not hitherto had a fair chance; engineers are allowed to mix the excreta with much water, and then to turn round and ask chemists to separate it again, forgetting that the "*reductio ad absurdum*" is *not* a chemical process.

Dickens, in his preface to the last edition of "Pickwick Papers," after referring to the great improvements which have taken place since he wrote the work, ventures a hope that "it may some day be discovered that the universal diffusion of common decency and health is as much the right of the poorest of the poor as it is indispensable to the safety of the rich and of the state; that a few petty boards and bodies—less than drops in the great ocean of humanity which roars around them—are not forever to let loose fever and consumption on God's creatures at their will, or always to keep their jobbing little fiddles going for a dance of death."

No. II.*

About twelve months ago, I read a paper on this subject before the Sewage Association of Glasgow; since then, the members of that association, with all their varieties of opinion, have passed one unanimous resolution—that, whatever system may be adopted, the excreta must be kept out of the public sewers, the expression of a conviction which will be that of any patient inquirer into this difficult question.

In the paper referred to, I endeavoured to show that, whatever may be the best, the present water-closet system, with all its boasted advantages, is the worst that can be generally adopted; briefly, because it is a most extravagant method of converting a mole-hill into a mountain. It merely removes the bulk of our excreta from our cities, to choke our rivers with foul deposit, and rot at our neighbours' doors. It increases the death-rate, as well as all other rates, and introduces into our houses a most deadly enemy, in the shape of the sewer gases.

Since then, the report of Messrs. Bateman and Bazalgette has appeared, and it proposes (what every one knowing the views of the authors would at once have predicted) to put down miles of costly sewers to carry the excreta to the Ayrshire coast, where, perhaps, the inhabitants may oblige us to take it back again; in other words, to commit the error of London, and wake up in a few years to the same bitter repentance.

We cannot be surprised at this; we cannot expect homœopathic treatment from an allopathic physician, especially if, as in this case, "bleeding" is to be again the universal cure. The engineer's treatment of town excreta always reminds me of the country doctor in America, who put all his feverish patients through a course of convulsions, because, though he didn't understand *fevers*, he *could* cure *fits*. In our numerous discussions, I have always maintained that chemists have been most unfairly treated in this matter. The public like to see what they pay for; they can see bricks and mortar and therefore have allowed engineers to give them an intimate pocket-purse knowledge of this expensive commodity, for which they have paid in more than one sense—through the nose. Engineers have too fondly believed that water is the great purifier, and so they dilute the excreta with 365 times its bulk of water, and reduce its value to 1d. per ton, and then turn round on the chemist and expect him to reverse the process, pick out the penny, and repay the expenditure. Now, if it were a simple mixture—if it were only to separate the grain of wheat from the sack of chaff—the problem would be difficult enough; but we know the case to be far worse than this—it is the handful of yeast in the sack of flour that we are called upon to extract, and the fermentation of which we are expected to prevent, *after* it has occurred. A small portion of dilute sewage, mixed with a large excess of water, soon renders it all equally offensive, and the problem of extracting its value is one which no chemist need ever attempt to solve.

The water-closet, with many apparent advantages, and with all our prejudices in its favour, carries an attendant train of evils, which I am fully persuaded will ultimately doom it to oblivion.

As, therefore, engineers have not put the subject fairly before chemists, I propose to take a noble revenge, and put the subject fairly before engineers. I ask them why they consider water to be the only vehicle for removing excreta?—why not earth?—why not air? Have they ever fairly investigated or thoroughly experimented on the other methods? Have they not rather confined their studies to *fits*, and forgotten *fevers*?

So many attempts have been made by chemists to pick up the halfpence that engineers have so plentifully flung into the mud, that I cannot even notice them, except to remark that, in the opinion of all the scientific chemists who have specially investigated these attempts, they have all signally failed.

I must allude, however, to the process of Mr. Chapman, as one of the latest methods of dealing with town sewage; this is a process of distillation, after treating with lime and thorough putrefaction. He confesses his difficulty, by wishing to

* Read before the Chemical Section of the Glasgow Philosophical Society, April 19th, 1869.

age of this city from 31,000,000 gallons to 1,000,000 gallons daily. This, of course, requires a complete alteration in the existing system, and it still dilutes the excreta with more than ten times its bulk of water. The lime process, and the putrefaction required to decompose the urea, would be extremely offensive, and require vast storing tanks. In working 1,000,000 gallons daily (it would more probably amount to 2,000,000 gallons); he would have to treat 4464 tons daily, the total chemical (not the extractible) value of which is 2s. 6d. per ton; and he expects to do this with 20 tons of coal. He proposes to adopt an ingenious arrangement of eight boilers, steaming exhaustively, to distil off the ammonia, heating up the feed sewage, after precipitation by lime, by the hot water discharged from the boilers by a kind of brew-house refrigerator with its object reversed. He expects to distil off 1-12th; but I think it must be at least 1-10th, or 100,000 gallons, evaporated by 20 tons of coal =5,000 gallons to 1 ton. The report of Professors Lyon Playfair and Johnstone puts the average evaporation for Scotch coal at 7·7 tons, or 1712 gallons per ton, and at this rate 58 tons would be required for the mere evaporation. Then, for raising the heat, the same report says that 1 ton of Scotch coal raises 56 tons of water from 32° to 212° F., or, say, 50 tons of water from 52° to 212° F., requiring, therefore, 96 tons for heating up, making a total of 148 tons a day. Mr. Chapman, therefore, expects to save, by heating feed water, and by exhaustive steaming, a total of 128 tons of coal daily, or 600 per cent. Can this be done? If it can, then whatever may be the result of his process, as applied to sewage, it will make him the greatest and most daring authority on that equally important subject, the economy of fuel. He puts down no loss for radiation. This should, I think, be at least 10 per cent, which would require nearly as much as his total calculated expenditure for fuel. In using eight boilers, of 4,000 gallons each, he expects to get off all the ammonia in half an hour's steaming. Now, we all know that the estimation of free ammonia in the laboratory is one of the most tedious processes, requiring a long-continued ebullition, and the experience of distillers, on the large scale, amply corroborates this, and proves that it does not pay to distil liquors containing under 1 per cent of ammonia (some manufacturers double this estimate). The total amount in the sewage to be distilled would be under 0·2 per cent; I think, therefore, that the process of Mr. Glassford, of evaporation with sulphuric acid (for which I must refer you to his pamphlet on London sewage), is better than this; fuel is the great question in both, but in his the results are certain, in Mr. Chapman's they are problematical.

Both are, however, connected with the water system, which I believe to be a mistake, and I think we must ultimately come, either to a system like Capt. Tiernur's, by what may be called pneumatic despatch, or to the dry-closet system. Of the former I have fully treated in a former paper, and wish now to speak more particularly of the latter. During the past year, Moule's dry-closet has been largely introduced; all who have used it speak in the highest terms of its efficiency, and there are already strong indications of its becoming the system of the future. It is the only system that has succeeded during the hot fortnight at the Wimbledon meeting; and it is particularly adapted to hot climates, where the evils of the water-closet are most conspicuous. The objections urged against the system, when earth is used, are—1st, the large quantity of earth required—three and a half times the weight of the excreta; and, 2nd, the difficulty of obtaining the quantity required, and of drying it. Now, both these difficulties are disposed of by using charcoal. I employ, by preference, sea-weed charcoal, because it is the most porous, the best absorbent, and the cheapest. It only requires one-fourth of the weight, compared to earth; and when the mixture is removed and placed under cover, it soon dries. This mixture can be stored for any length of time, and used again several times. When convenient, it is re-burned, like the char in sugar refineries, except that this process is carried out in apparatus which admits of collecting the ammonia and other products condensed. The whole of the ammonia is thus collected; whilst the phosphoric acid, potash, and mineral matters accumulate in the charcoal, together with the carbon from the organic constituents of the excreta. The weight of the charcoal is increased to the extent of about 5 per cent with each using, and, if dried and re-used five times, about 25 per cent with each re-burning. With this constant addition, the char does not require replacing with fresh material, so that its cost is only a primary outlay—the ultimate result being that the excreta is deodorised by a charcoal derived from itself, and a company working this process would, in addition to securing the whole of the ammonia, become sellers of a charcoal second only in value to that from bones to the extent of, in Glasgow, if the process were general, 19 tons a day, or 6,935 tons a year; the total quantity of excreta which Glasgow has to remove being 385 tons a day, and its value, at 29s. 6d. per ton, =£569.* The ultimate result being the same, any charcoal may be used at first. The process is carried out without odour, from the closets to the finished products. Of course the process may be modified; for instance, suppose the char to be used five times, and only dried, the addition to its value would be as follows (I take equal parts, as this charcoal will absorb at least an equal weight of even urine):—

1 ton seaweed char, at £2 } =30 cwts. manure at £9 7s. 6d.
5 tons excreta, at 29s. 6d. } =£6 5s. per ton.

Or, if re-burnt, it would yield 25 cwts. of charcoal, and the whole of the nitrogen would pass over in the distillation, as ammonia. Dr. Wallace estimates the cost of re-burning char in sugar refineries at 3s. 6d. per ton for labour and fuel, containing 31 per cent moisture, which would be much over that referred to. Here, then, we have a simple process for recovering the whole of the value from excreta, of general application, and the results of which can be predicted by chemists with absolute certainty, as far as those products to which we at present attach value are concerned; but the uncertain portion is, as usual, the most interesting, for in the destructive distillation of excreta we are exploring a new field, which promises great interest.

I regret that I am obliged to bring this paper forward before the new products have been studied. The distillation generally is remarkably similar in its products to that of bones, and also to that, which most resembles it, of sea-weed. Besides ammonia, acetic acid, with a little butyric acid, acetone, and pyrrol are the most marked bodies. I cannot speak more definitely of these products in this paper, as they are still under investigation. The following analysis of urine is taken from Miller, representing the average compo-

* Value given in my former paper.

sition in 1,000 grs., sp. gr. 1,020. The calculated percentage of nitrogen is appended:—

			Nitrogen.	In 100 parts of solid matter.	Nitrogen.
		Water	956·80		
Solid Matter, 43·20.	Organic, 29·97.	Urea	14·23	6·64	33·00	15·40
		Uric Acid	0·37	0·12	0·86	0·27
				6·76		15·67
		Alcoholic extract	12·53		29·03	
		Watery extract	2·50		5·80	
		Vesical mucus	0·16		0·37	
	Inorganic, 13·35.	Chloride of sodium	7·22		16·73	
		Phosphoric acid	2·12		4·91	
		Sulphuric acid	1·70		3·94	
		Lime	0·21		0·49	
		Magnesia	0·12		0·28	
		Potash	1·93		4·47	
		Soda	0·05		0·12	
			999·94		100·00	

6·76 = NH_3 8·2, Sulphate of ammonia, 31·86, or 3·18 per cent.

15·67 = NH_3 19, Sulphate of ammonia, 73·72.

The average portion voided by each individual may be taken at 40 ozs., and of fæces, 4 ozs., total 44 ozs. daily; or, 1·7 ozs., solid, from urine, and 1 oz., solid, from fæces —total of 2·7 ozs. solid excreta daily. The following analysis of the fæces is from Berzelius:—

Water	75·3		
Bile	0·9	5·7	Containing, according to Playfair— 15 p. c. nitrogen, and 45 p. c. carbon, and about 25 p. c. ash. =nitrogen 3·75 p. c. =4·55 NH_3. =17·65 p. c. sulphate of ammonia. =70·71 in dry solid matter.
Albumen	0·9		
Extractive matter	2·7		
Salts	1·2		
Insoluble residues of digested food	7·0	7·0	
Insoluble matters added in intestinal canal—mucus, biliary resin, and peculiar animal fat	12·0	12·0	
	100·00	Solid matter, 24·7.	

The ash contains, according to Porter:—

	Ash of Fæces.		Ash of Urine (calculated).
Chloride of sodium	1·33	....	54·15
Phosphoric acid	36·03	....	15 89
Sulphuric acid	3·13	....	12·73
Lime	26 46	....	1·57
Magnesia	10·54	....	0·89
Potash	6·10	....	14·45
Soda	5·07	....	0·38
Peroxide of iron	2·50	....	——
Carbonic acid	5·07	....	——

Assuming, then, the proportions voided to be in the proportion of 17 dry, from urine, to 10 dry, from fæces, the resulting chars may be expected to have the following composition:—

	Urine.		Fæces.		Mixed Excreta.
Percentage of char in dry solid matter	50	..	70	..	57
Ammonia=sulphate	73·72	..	70·71	..	72·60

COMPOSITION OF CHARS.

	Per cent.		Per cent.		Per cent.
Carbon	33·33	..	45·00	..	37·65
Chloride of sodium	36·10	..	0·33	..	9·51
Phosphoric acid	10·60	..	9·01	..	10 01
Sulphuric acid	8·49	..	0·78	..	5·63
Lime	1·05	..	6·61	..	3·11
Magnesia	0·60	..	2·63	..	1·35
Potash	9·64	..	1·52	..	6·63
Soda	0·26	..	1·26	..	0·63
Peroxide of iron	——	..	0·62	..	0·23
Carbonic acid	——	..	1·26	..	0·46

The nitrogen in the mixed excreta, in the proportions voided, is equal to 4·49 per cent of sulphate of ammonia.

In the char from urine, the phosphoric acid is principally combined with potash, and therefore soluble. This char alone would be a valuable manure as containing a large proportion of soluble phosphates; but the result of commencing with seaweed charcoal, which is rich in carbonate of lime, will be to form phosphate of lime at the expense of the carbonate—in other words, to form, by treatment with urine, re-burning, and washing, the animal charcoal required by the sugar refiner. This expected result is verified in the following tables of analyses. I regard the phosphate of lime thus gradually formed, from its minute state of division, to be quite equal, in agricultural value, to ordinary soluble phosphate. The washed residual char from fæces is at once available for the refiner, as it contains about 26 per cent of phosphates of lime and magnesia, with but a small proportion of carbonate. I know no reason why the product of disintegrated bone and muscle should not be used for this purpose as well as the bones themselves.

In distilling 100 tons of the dry product from mixed excreta, therefore, we should obtain 72 tons of sulphate of ammonia, and 57 tons of charcoal, containing 10 per cent of phosphoric acid in its most available form for manure, and 6 per cent of potash. It will be seen, from Berzelius's analysis, that nearly 50 per cent of the fæces consist of fatty matter—how will this appear in the distillation? In a population of 500,000 this item amounts to nearly 7 tons a day!

I expected a loss of ammonia in drying, but it is very small, and appears to arise from the free lime in the char, as it will be seen further on that the loss decreases in using the char with urine. In a small experiment with urine, I found the total loss, in drying by artificial heat with new char, to be 2·06 per cent of the ammonia, or 0·105 per cent of the urine employed.

I append analysis of 1 lb. of char which was re-burnt fifteen times with an equal weight of urine; a portion of the char was lost, which prevents my giving the increase in weight; I believe, however, the addition of carbon would be too slight to effect an increase in the total, with so many re-burnings. The percentage is decreased:—

	Char used.		After re-burning.		Increase per cent
Water	10·0	..	2·80	..	——
Soluble salts	0·6	..	11·15	..	10·55
Insoluble	89·4	..	86·05	..	——
Soluble.					
* Chloride of sodium	——	..	8·75	..	8·75
Sulphuric acid	0·3	..	0·34	..	0·04
Phosphoric acid	——	..	2·00	..	2 00
Potash	0·3	..	2·40	..	2·10
Insoluble.					
Carbon	54·4	..	29·40	..	——
Silica, &c	9·1	..	13·10	..	4·00
Phosphate of lime	4·08	..	20·05	..	15·25
Carbonate of lime	17·4	..	19·75	..	2·35
Carbonate of magnesia	3·4	..	3·40	..	——

The urine used appears to have been deficient in sulphates and high in phosphates, these two ingredients being subject to considerable relative variation. The distillates gave 192 ozs. liquid, containing free ammonia equal to 3,047 grs. sulphate, or 2·9 per cent of the urine, showing a slight loss, inseparable from destructive distillations on the small scales. The charcoal

* In this and the following analyses, the whole of the chlorine has been calculated, for convenience, as chloride of sodium, which, in some cases, is therefore too high.

	Increase, per cent.				Increase, per 1,000 grs. of Urine.			
	1.	2.	3.	4.	1.	2.	3.	4.
Dry solid matter	33·30	62·50	210·00	347·94	33·30	31·25	42·00	34·79
Char	7·50	12·90	80·40	151·96	7·50	6·45	16·40	15·19
Ammonia sulphate	21·70	36·80	51·12	105·64	29·00	29·90	31·60	47·31

Residual Chars.

	Composition, per cent.					Increase, per cent.				Increase, per 1,000 grs. of Urine.			
	Ordinary Char.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.
Water	10·00	1·60	3·00	—	—	—	—	—	—	—	—	—	—
Soluble salts	0·60	15·80	19·80	39·40	52·20	15·20	19·20	38·80	51·60	20·40	15·70	24·30	22·78
Insoluble	89·40	82·60	77·20	60·60	47·80	—	—	—	*41·60	2·04	23·90	19·60	12·47
Soluble.													
Chloride of sodium	—	5·40	13·10	28·02	24·70	5·40	13·10	28·02	24·70	7·18	10·60	17·30	11·06
Sulphuric acid	0·30	2·05	3·29	3·77	3·77	1·75	2·99	3·47	3·47	2·33	2·64	2·21	1·62
Phosphoric acid	—	2·20	0·40	trace	1·60	2·20	0·40	—	1·60	2·92	0·32	—	0·71
Potash	0·30	2·80	4·99	7·00	10·38	2·50	4·69	6·70	10·08	3·32	3·89	4·10	4·62
Insoluble.													
Carbon	54·40	37·40	40·00	35·40	28·20	—	—	—	*26·20	*4·50	5·30	11·06	7·19
Silica, &c.	9·10	13·60	10·00	8·00	4·40	4·50	0·90	—	*4·60	8·98	3·57	3·14	1·06
Phosphate of lime	4·80	8·00	9·60	11·40	10·20	3·20	4·80	6·60	5·40	5·84	5·40	6·10	4·08
Carbonate of lime	17·40	20·40	13·20	4·20	1·15	—	—	—	*16·25	9·73	2·00	*0·88	*1·22
Carbonate of magnesia	3·10	5·40	3·16	1·93	1·20	2·30	0·06	—	*1·90	4·08	0·98	0·57	0·23

Washed Chars.

	Composition, per cent.					Increase, per cent.			
	Ordinary Char.	1.	2.	3.	4.	1.	2.		
Carbon	54·40	45·30	51·80	58·40	59·40	9·10	*2·60	4·00	4·60
Phosphate of lime	4·80	9·60	12·40	18·80	21·34	4·80	7·60	14·80	16·54
Carbonate of lime	17·40	24·60	17·10	6·90	2·40	7·20	*0·30	*10·50	*15·00
Carbonate of magnesia	3·10	6·50	4·10	3·10	2·51	3·40	1·00	—	*0·59

* Decrease.

should be used at least five times before re-burning, and for urine alone it may be employed ten times. I append a table, showing the analytical results of this process with urine.

No. 1 is from charcoal dried up with ten times its weight of urine before re-burning; No. 2 has been treated with twenty times its weight, No. 3 with fifty times its weight, and No. 4 with 100 times its weight of urine before re-burning. It will be seen, that in No. 4 more than the theoretical amount of ammonia is obtained; that from Nos. 1, 2, and 3 are obtained by simple destructive distillation. No. 4 only yields ammonia equal to 50·48 per cent of sulphate when heated in this way, the quantity given, 105·64 per cent, being that obtained with soda-lime; the residual nitrogen is not left in the char, but goes off in the distillation in some other form than ammonia. I shall recur to this subject in a subsequent paper. The retention of nitrogen after drying is, however, extraordinary when the product yields ammonia equal to 105 per cent of sulphate. No Peruvian guano can be compared to this in fertilising value.

The washed chars acquire the composition which fit them eminently for the sugar refiner.

The experiments with closet excreta are unfinished, and it is difficult, in working on small quantities, to obtain uniform results. We find one of Smith's dry-closets use ½ lb. of seaweed char per charge, the charge of dry earth being 2 lbs. Moule's closet uses rather less. There were seven uses in our first experiment, the contents of the pail being re-burnt at once, without drying.

Weight before distillation	130 ozs.
Residual char weighed	48 "
Weight of excreta 82 ozs. = 11·7	" per use.

The distillation gave 66 ozs. of gas liquor containing free ammonia = 1·8 ozs. sulphate = 3·4 per cent of mixed excreta; this represents only the free ammonia, or that existing as carbonate; a portion is combined with acetic acid, which was not estimated.

The same method is equally well adapted for treating pot ale from distilleries, and blood and offal from slaughter-houses. The former is an important subject in Glasgow, and I can in this paper only shortly allude to it. According to Dr. Wallace, one of the distilleries in Glasgow sends into the sewers 83,000 gallons of this pot ale, containing nitrogen equal to 118 grs. of ammonia per gallon; so that the daily discharge of this one distillery is equal to the total excreta of 48,970 persons, or one-tenth the population of Glasgow.

The process can be adapted with ease to urinals as well as closets. I am enabled to exhibit some mixtures of charcoal and night soil made twelve months ago. I was curious to know if these mixtures had gone further in the oxidation of the ammonia, and formed some nitrates, but not a trace can be detected.

I submit that the dry-closet system, with this process, has the following great advantages:—

1. Total freedom from all odour. All must have noticed sometimes the sickly odour of a water-closet, arising, not from the excreta, but from the gas from the sewers.

2. Certain prevention of all contamination and spread of infectious diseases arising from sewer leakage into our wells or sewer gas into our houses.

3. Saving of water, equal, in Glasgow, to £40,000 a year, if the water-closet system were general.

4. Saving of expense in repairs and removal. 1 cwt. of charcoal per month is sufficient for each closet when used by six persons daily, and the whole may be allowed to fall at once from the closet, through a 12-inch pipe, to a cesspit below the house. A *cesspool* is a serious evil, but I know of no evil to a *cesspit*.

5. By this process alone can the whole of the valuable material be recovered for our lands.

Dr. Fergus has shown some remarkable examples in which gastric fever has been traced to the escape of sewer gas through small openings eaten through the top of the soil-pipe. This appears to be a wide-spread evil. I have examined some of these specimens, and find the substance to be a sort of lead plaster, containing, also, lime and some fatty acid, which requires further examination. I have shown that only remedial measures can be adopted, where the water-closet system has been carried out, by placing boxes of charcoal in the closets, and filtering the sewage through charcoal before allowing it to enter rivers.

Our authorities want, of course, some grand scheme; but they forget that the question is one of minute details. We are assailed by a large army of small nuisances—one, at least, to every house, and we must attack them one at a time. Attacked in their united strength, they will assuredly overcome us. Ought we not rather to strike at the root of the evil? Ought we not to stop the mischief at its numerous sources, and before these can combine into a mighty force, which carries everything before it?

Let the subject be calmly and carefully discussed; let us not be carried away by great schemes and useless expenditure; let us not leave to posterity heavy taxes, with barren wastes and desolate cities, but let us rather pay our own way, and leave our country fertile and our towns pure, and I shall never regret that, however imperfectly this subject has been brought before you, my earnest wish has been to strike "one more blow for life."

A lively discussion followed the reading of the paper, the general opinion of the members of the section being highly favourable to the process, which was considered the most novel and practical which has yet been introduced.

ON THE FUNCTIONS OF NUCLEI

WITH RESPECT TO GASEOUS, SALINE, AND VAPOROUS SOLUTIONS.*

BY CHARLES TOMLINSON, F.R.S., F.C.S.

As every one here present is engaged in conducting processes in chemistry and pharmacy, you will, I am sure, be interested in some new experiments connected with the solution of gases, crystallisation, ebullition, and distillation, which I shall have the honour of performing before you.

You know that when a bottle of soda-water is emptied into a glass, there is not only an escape of gas from the surface of the liquid, but innumerable bubbles become attached to the inner surface of the glass. A crumb of bread, thrown into the soda-water, produces a lively effervescence; and, if we put into it the finger, a strip of paper, a rod of glass, of metal, or of wood, it immediately becomes covered with gas. In fact, any solid acts as a *nucleus* in separating gas from solution; and I would define a nucleus as a body that has a stronger adhesion for the gas of a solution than for the water which holds the gas in solution.

Let us now take a glass that has been made chemically clean by being washed out with strong sulphuric acid, or caustic alkali, and copious rinsing with clean water. If the soda-water be poured into this, the results are very different. After the very first effervescence is over, the glass looks as if it were full of pure distilled water, not a bubble of gas is to be seen adhering to the sides, and there is no appearance of gas anywhere about it. I plunge into the liquid a glass rod that has been made chemically clean, or *catharised* as it may be called: there is no escape of gas, not a single bubble adheres to the glass rod. I put in clean iron filings: there is no liberation of gas. I pour some iron filings into my hand, and rub them about, and, on putting these into the soda-water, there is a furious, boiling effervescence.

Hence, you see, there is a marked distinction between a clean or *catharised* body, and an unclean body, or *nucleus* as it may be called.

The action of nuclei may be similarly traced in the case of certain salts that form supersaturated solutions. For example, 100 parts of water, at 212° F., will take up 357½ parts of potash alum; whereas, at 32°, the water will take up only 3·9 parts, and yet the solution, saturated at 212°, may be cooled down to 32°, without any separation of the salt, provided the vessel containing it be chemically clean, the solution clean, and means be taken to exclude the dust of the air. Such a solution is said to be *supersaturated*, because it holds more salt in solution than it can take up at the reduced temperature. In the case before us, a solution of alum, saturated at 212°, and cooled down to 32°, contains 90 times more salt in solution than it can take up at 32°. Here is a solution of alum, saturated at 194°, and containing 53 times more salt than the water, at 32°, can take up. You see it is a perfectly clear and bright solution, and may be shaken with impunity. It remains liquid and supersaturated simply because there is no nucleus to start the act of crystallisation. I take out the plug of cotton-wool from the flask; and you see how beautifully the surface of the solution becomes covered with a crystalline crust, while well-shaped octahedra grow downwards, until the whole mass is solid, and the flask quite warm from the heat developed by the change of state.

Here is a supersaturated solution of sodic sulphate in a narrow-necked flask. I take out the cotton-wool, and the solution does not crystallise; I touch the surface of the solution with a glass rod, and crystallisation instantly sets in.

Here are similar solutions of sodic sulphate and sodic acetate, each containing a solid, such as a bit of charcoal, of pumice-stone, of meerschaum, of coke, &c. These bodies, which would act as nuclei in inducing crystallisation if put into the cold solution, become inactive if boiled up with the solution, and allowed to cool down with it and in it; they are, in fact, chemically clean. I take the cotton-wool out of these flasks; some of the solutions will crystallise on the instant, others after a short time, others, again, after some hours. It depends very much on the size of the opening whether a speck of dust enter the flask; for, of course, the wider the opening, the more likely is it for the dust to find an entrance.

In the case of saline solutions, a nucleus may be defined as a body that has a stronger attraction for the salt of a solution than for the liquid which holds it in solution.

In general, a body that has been exposed to the p[illegible] or handled, or wiped with a cloth that has

* A lecture delivered at the *conversazione* of the Pharmaceutical Society, May 18th, 1869. Communicated, with additions and corrections, by the author.

handled, is covered with an oily, fatty, or greasy film, to which the water of the solution adheres either not at all, or less strongly than does the salt of the solution, and, hence, such a body introduced into the solution acts as a nucleus. Make the body chemically clean, and the solution adheres to it as a whole; that is, there is the same amount of adhesion between the nucleus and the water of the solution as there is between the nucleus and the salt of the solution, and, hence, there is no separation.

An extreme case of this kind of perfect adhesion on the part of chemically-clean surfaces and the solutions, may be seen in this flask. It contains a highly-supersaturated solution of sodic sulphate, resting upon a considerable mass of the modified 7-atom salt. This, being chemically clean, does not act as a nucleus to the rest of the solution. I can shake the flask violently, so as to break up and rattle about these crystals at the bottom, and the solution does not solidify. But now, look at this: I take out the cotton-wool, and, instantly, lines of crystals, closely packed together, diverge from some point on the surface, and the whole saline contents of the flask form one solid mass.

This differential kind of action which belongs to nuclei, may also be exhibited with reference to liquids at or near the boiling point. My definition of such a liquid is, that it is a supersaturated solution of its own vapour. It is a solution of vapour, constituted like the solution of carbonic acid in water, or of sodic sulphate or of alum in water.

Such being the case, a body introduced into a liquid at or near the boiling point acts or does not act as a nucleus in separating vapour, according as it is unclean or clean. If clean, the solution adheres to it perfectly, and there is no separation of vapour; if unclean, the vapour adheres to the surface as strongly as before, but the liquid adheres less strongly, or not at all, and, hence, there is a separation of vapour on the surface of the nucleus.

Now, you are all acquainted with a very unpleasant phenomenon that often accompanies the processes of boiling and distillation. I mean the *bumping* of the vessel, or *jumping ebullition*, as it is called (*soubresauts*, in the language of French science). This is generally brought about thus:—The liquid makes the interior of the vessel chemically clean, and the solution of vapour adheres to the clean surface with great force; the temperature rises above the boiling point, until the liquid not being able to dissolve any more vapour, a portion of the latter escapes with a burst along the line of least resistance, or towards the opening of the vessel. This upward action is accompanied by an equal reaction in a contrary direction, which tends to force the retort or flask further into the ring of the retort stand, or down upon any other support, and it is the rebound from this that causes the *soubresaut*. Now, for the purpose of preventing or mitigating this inconvenient and even dangerous action, it is the practice to introduce into the vessel certain angular or rough bodies, such as sand, pounded glass, bits of tobacco pipe, platinum, copper, &c. Such bodies have been called "promoters of vaporisation." How they act has not been explained, but it has often been noticed that they cease to act in liberating vapour after prolonged contact with the boiling liquid.

I need scarcely say that such bodies cease to act as nuclei in liberating vapour from solution as soon as they become chemically clean.

Now, here is water boiling in a clean flask with some difficulty and a disposition towards bumping. I put into the flask a pinch of sand from the sand bath, and the boiling immediately becomes soft and regular, and there is no tendency whatever to bumping.

But suppose we make the sand chemically clean, by heating it in contact with strong sulphuric acid, rinsing with water, washing with alkali, and again rinsing. Such sand, in very small quantity, in a chemically-clean flask containing clean distilled water, will increase the bumping to a remarkable extent. Here is such a flask, standing over a spirit lamp. You see that it bounds up from the support with explosive force, and one wonders the flask is not shivered to pieces. The bits of glass, &c., put into a retort containing alcohol, ether, &c., soon behave in this way, for the liquid makes them, as well as the interior of the vessel, chemically clean, and, in such case, we multiply the adhesion surfaces, when what is wanted is an extension of the vapour-giving surfaces.

It is clearly wrong to employ as nuclei bodies that soon cease to act as such, supposing it were possible to find permanent nuclei. Porous bodies, such as charcoal, coke, pumice-stone, &c., perform this useful function. The same force which enables a piece of boxwood charcoal, for example, to absorb 95 times its volume of ammoniacal gas, causes the charcoal, in the midst of a hot solution of vapour, to absorb vapour, and, under the continued action of heat, to give it out again, in a constant, never-ceasing flow.

Indeed, what is remarkable is the permanent action of these porous bodies. I have tried the same piece of charcoal or of coke in boiling liquids over and over again, for weeks together, and never found the vapour-giving action to flag. I have boiled these porous bodies in strong acids, washed them in alkalies, and made them in all respects chemically clean, without at all interfering with their vapour-separating action in boiling liquids. They do not act as nuclei in separating salt from solution if boiled up with it and allowed to cool in it; their peculiar function is to separate vapour from liquids, at or near the boiling point; and this they do by their capillarity. I have, in this flask, a bundle of glass capillary tubes, united like a faggot, by means of a thread in the middle. This acts vigorously in separating vapour from the liquid at the boiling point, and, even after the lamp has been removed from under the flask, the tubes continue for some time to discharge vapour from their ends.

Among the charcoals, the most efficient as a vapour nucleus is charcoal from cocoa-nut shell. This is very dense, and sinks below the surface of liquids denser than water, which is a great advantage.

It will, I think, be worth your while to come up, after the lecture, and watch closely this large flask of water, containing some pieces of cocoa-nut shell charcoal. The vapour passes off from each piece in perfect torrents, and there are these two remarkable advantages connected with the action, namely, bumping is entirely prevented, and the amount of distillate is largely increased, in some cases as much from 30 to 50 per cent, with the same amount of heat, in the same time, as compared with the process without the use of the charcoal.

For example, methylated spirit of wine, boiling at 171° F., was distilled in a glass retort. The distillate collected in five minutes weighed 244 grains. Three or four fragments of charcoal, partly boxwood and partly cocoa-nut shell, weighing only 20 grains, were added to the retort. The distillate, in five minutes, was now

325 grains. The ratio of the results is 100 : 133·2. With 20 grains of pumice-stone, the results were as 100 : 121·7; with 20 grains of meerschaum, as 100 : 112; and with 20 grains of coke, as 100 : 107·46.

But these results are understated; for the retort contained some porous specks of iron or charcoal, which get attached to most glass vessels during the process of manufacture, and which act as powerful nuclei in separating vapour from boiling liquids. Indeed, were it not for these accidental impurities, many a chemical operation must fail from excessive bumping.

But, as I promised to make this a short lecture, I must conclude. You see that there is a harmony of action in the behaviour of nuclei with regard to gaseous, saline, and vaporous solutions; and, from this action, we get a clear view of the functions of nuclei, and also get rid of much speculation as to "molecular action," and "the mysterious action of the air," which some observers indulge in when treating of supersaturated solutions.

DECOMPOSITION OF REFRACTORY SILICATES BY FLUORIDES IN THE WET WAY.

BY CHARLES E. AVERY,

STUDENT IN THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

I find that silica and silicates, such as felspar and glass, may be completely dissolved in the cold by a mixture of some normal fluoride with almost any of the stronger acids, whether concentrated or dilute.

When mixed with the fluorides of sodium, barium, aluminum, lead, or the double fluorides of these metals, the silicates in question can be readily decomposed by nitric, chlorhydric and sulphuric acids, either concentrated or diluted with four volumes of water.

If strong sulphuric acid is used, a part of the silicon passes off as gas; if the dilute acid is used, portions of many silicates remain undissolved as insoluble sulphates.

The same decomposition of the silicates is effected, though less easily, by the action of oxalic, acetic, tartaric, and like acids, on the mixed fluoride and silicate. Carbonic acid, even as dilute as in the air, does the same thing, but less rapidly.

Strong nitric acid gives a perfect solution and acts rapidly, dissolving a moderately fine powder of felspar or quartz in a few hours even in the cold. The loss of silica is very slight if the experiment is properly conducted; hence, all the constituents of a siliceous mineral can be estimated in the solution produced.

In analysing the silicates in this way, it is best to use the fluoride of some metal which is not to be estimated in the analysis; since, if we use a fluoride whose metal is present in the mineral, we must know the weight of fluoride taken. Of the various fluorides those of barium and lead seem to me the most promising.

An objection to the use of fluoride of ammonium is that, as usually made, it contains sulphate of ammonium, so that insoluble sulphates might be formed and solution retarded.

If fluoride of sodium, as made from cryolite, were not so hard to purify, it would be well fitted for the analysis of silicates free from sodium.

It has long been known that acid fluorides attack the silicates, and that even acetic acid can change normal into acid fluorides; but, so far as I know, no one has before shown that the action of acids is sufficiently rapid and complete, in the cold, to be useful in analysis. In another paper, I shall give the details of the process of solution, the method of analysis, and the means of making the fluorides.

Boston, February, 1869.

CHEMICAL EXAMINATION OF THE ORIENTAL JARGON.*

BY DAVID FORBES, F.R.S., &c.

A short time back, I undertook, at the request of Mr. Sorby, to prepare for him some of the earth or earths which, in combination with silicic acid, formed this gem, and as the means I employed in so doing appeared to throw some little light upon the characters of the earth hitherto regarded as zirconia, I have thought that a notice of the results obtained by me might not be devoid of interest.

The jargon employed was in fragments, being part of an almost colourless crystal, forwarded to me by Mr. Sorby, who had previously found, by optical examination, that it showed with great distinctness the peculiar and characteristic spectrum which he ascribes to the presence of the new element jargonium, and noticed that the bands became much more pronounced after ignition and cooling.

The fragments, which were extremely hard, were broken up in a diamond mortar, previous to being reduced to as impalpably fine a powder as possible in an agate mortar; 16·22 grains of this powder were then thoroughly mixed with 81 grains pure anhydrous carbonate of soda, placed in a platinum crucible, and fused at the highest heat of a large air gas blowpipe jet, after having been previously kept for two hours over a powerfull Bunsen's flame, so as to "frit it," or ensure combination previous to fusion. After complete fusion, a small lump of pure hydrate of soda (about 15 grains) was, as recommended by Berzelius, carefully deposited in the centre of the fused mass, and a second similar piece added after the first had been absorbed; the fused substance became much more liquid after this addition; the heat was kept up for another half hour longer, and the whole was allowed to cool.

By the above means the mineral was perfectly decomposed, and the silica so altogether transferred to the soda that it could be completely removed by cold water, leaving no trace behind with the earths. Previous experience with the zircons from various localities, and hyacinths from Ceylon, had proved to me that the perfect decomposition of these minerals is often attended with considerable difficulty.

The fused mass when cold was treated repeatedly with cold water in a silver vessel, decanting off the supernatant solution each time, until the silica was entirely removed, and a white powder, probably a compound of the earth with soda, remained behind.

The solution which contained all the silica was acidified with hydrochloric acid, evaporated to dryness, and the silica determined as usual. The silica obtained weighed 5·45 grains, consequently was equivalent to 33·61 per cent in the mineral.

The white insoluble residue previously mentioned, was found to be perfectly soluble in hydrochloric acid; in order to test if it contained any silica, the solution was evaporated to dryness and re-dissolved in water

* Although in commerce this mineral is generally known as the jargon from Ceylon, the name Oriental jargon seems to me to be preferable, since it appears uncertain whether these stones are actually found in the Island of Ceylon, that place being well known as the Eastern mart for precious stones procured from Pegu, Siam, and the adjacent countries.

acidulated by HCl, but left no trace of insoluble matter behind. From the colour of the solution being distinctly yellow, it evidently contained oxide of iron, which I had scarcely expected, since the original mineral was nearly, if not altogether, devoid of colour; the solution, consequently, was a chloride of the earths of the jargon, accompanied by some sesquichloride of iron.

Berzelius many years ago devised a means of separating oxide of iron from zirconia, founded upon the behaviour of their respective chlorides, the sesquichloride of iron being soluble in strong hydrochloric acid, whilst that of zirconia is nearly insoluble; I had tried this process previously with zirconia from Ceylon hyacinths, and had not been satisfied with it, as the iron solution carried along with it a not inconsiderable portion of the earth. It now struck me, however, that possibly the earth so dissolved might differ in character from that contained in the insoluble chloride, and I therefore determined to make the experiment.

The hydrochloric acid solution was consequently again evaporated until it solidified as a yellow saline mass, whereupon it was treated repeatedly with cold strong hydrochloric acid of density 1·138, allowing it to stand some time and decanting the solution as long as the fresh acid acquired the faintest yellow tinge. A yellow solution was obtained, leaving behind a snow-white chloride, crystalline in appearance and completely soluble in water, forming a perfectly colourless solution. From this solution ammonia precipitated a flocky, but apparently rather dense, white precipitate, which, after being thoroughly washed, dried, and ignited, was of a pure white colour and possessed a peculiar waxy look and dense appearance; it weighed 7·48 grains, and consequently amounted to 46·12 per cent of the jargon examined.

This earth was examined optically by Mr. Sorby, and, according to his account, did not give a trace of the characteristic jargonium bands in the spectrum, and it was, therefore, concluded to be pure zirconia.

The yellow hydrochloric acid solution was now examined, and found, besides sesquioxide of iron, to contain a considerable amount of an earthy base, like zirconia. I decided to separate the iron by the tartaric acid and sulphide of ammonia process recommended by Berzelius, and, consequently, the solution was first supersaturated by ammonia, which threw down a faint yellowish white somewhat flocculent precipitate. Tartaric acid in excess was then added, which dissolved at once the greater part of the precipitate, but, notwithstanding that a very large excess was added, a portion of the precipitate refused obstinately to re-dissolve, even upon application of heat. In order to examine this, the solution was filtered: a white, flocculent, and somewhat glutinous substance was left upon the filter, which, when well washed with hot water, dried, and ignited, weighed 1·24 grains, equivalent to 7·64 per cent of the original mineral.

This body, after ignition, appeared very different from the previously-obtained zirconia; it was a white powder, but did not aggregate together or form lumps having a waxy lustre on the surfaces of fracture; on the contrary, it was more pulverulent, had a dead white, or mealy, appearance, and did not appear to be of any great density.

From Mr. Sorby I learn that it gave the spectrum of jargonium with intensity, and he concludes that it must probably be its pure oxide or jargonia.

Ammonia was now added in excess to the tartaric *acid solution*, which remained clear. Upon the further addition of sulphide of ammonium, the solution assumed a dark brown coloration; but no precipitate separated before the lapse of some days, when a black deposit of sulphide of iron formed, which was collected upon a filter, after the greater part of the supernatant liquid had been carefully syphoned off.

This sulphide of iron was converted into sesquioxide, and afforded 0·04 grain, equivalent to 0·24 per cent in the mineral.

After separation of the iron, the solution was evaporated to dryness in a platinum capsule, and ignited for some time, to drive off all ammoniacal salts, and oxidise the carbon resulting from the decomposition of the tartaric acid. There then remained behind an earthy body, of a white colour, having a slight tinge of grey, which weighed 2·03 grains, or 12·52 per cent.

In appearance, this earth was quite different from the zirconia, and more resembled that supposed to be jargonia. Mr. Sorby, upon optical examination, reports that "It seems to contain a good deal of zirconia and a very decided trace of jargonia, but I am very much inclined to suspect that it may contain some other substance. Its behaviour with borax before the blowpipe is very different from that of the zirconia from the jargon, and it turns extremely opaque, and a sort of orange-yellow, by transmitted light." Possibly this substance may contain a third earth analogous to zirconia, such as Svanberg (*Ofversigt. Kongl. Vet. Acad.*, pp. 34, 37, 1845) suggested was present in eudialite and certain zircons.

The result of this examination of the jargon, when summed up, indicates its composition to be as follows:—

	In 16·22 grains.		In percentage.	
Silica	5·45		33·61	
Zirconia α	7·48	10·75	46·12	66·28
" β (jargonia?)	1·24		7·64	
" γ	2·03		12·52	
Sesquioxide of iron	0·04		0·24	
	16·24		100·13	

The formula ZrO_2SiO_2 ascribed to zircon requires—

Silicic acid	33·77
Zirconia	66·23
	100·00

with which the numbers found for jargon are closely approximative.

The results of this chemical examination must be considered as strengthening the evidence, physical and chemical, that the earth usually denominated zirconia is, in reality, a compound of two, if not more, closely-allied oxides. In 1845, Svanberg announced that the zirconia contained in the various zircons from Siberia, Norway, and Ceylon, as, also, in the hyacinths from Expailly and Ceylon, was a compound of two or more earths, one of which he termed noria; and, in a subsequent paper the same year, also found this to be the case with the earth in the Greenland eudialite. His arguments—for he did not succeed in separating the earths—were founded upon his observations that the salts of zirconia did not always contain the same constant proportion of acid to base; that the oxalates, chlorides, and sulphates differed in their behaviour and solubility in certain reagents, and that the specific gravities of the natural silicates (zircon) from various localities differed greatly from one another.

These observations of Svanberg, notwithstanding the promise contained in his short paper on the subject to bring forward fuller evidence, have, as yet, never been

followed up by him, and the subsequent researches of other chemists appear to throw doubt as to their correctness in several points, as well as to render the existence of his noria extremely dubious. The researches of Berlin (*Journ. f. Prak. Chemie*, lviii., p. 145, 1853) showed that the results of the fractional precipitation of chloride of zirconia by oxalic acid did not warrant the conclusions of Svanberg, and that the zirconia prepared from zircons from Frederiksvaern, Expailly, Ural, India, and from the Ceylon hyacinths and Norwegian katapleeite, behaved in similar manner with oxalic acid, and that their oxalates were easily and completely soluble in excess of that acid, and that the specific gravity and amount of zirconia obtained from the oxalates from Frederiksvaern zircon and katapleeite which he examined were identical, so that it would seem necessary to seek for some other means of separating the earths than by the employment of oxalic acid. In some experiments I made for the purpose of attempting to isolate noria (in which I used Norwegian zircons from two different localities, and also hyacinth from Ceylon), I failed in so doing, but corroborated the results obtained by Berlin.

In 1864, Nylander, in a paper, "Bidrag til Kännedomen om Zirkonjord" (*Acta Universitatis Lundensis*, 1864), has examined the zirconia from the Norwegian eucolite, and considers that it contains two earths, which differ in their behaviour and solubility of their double potassium sulphate salts, but he also appears to have come to no definite results as to the existence or isolation of the earths themselves.

It is to be hoped, however, that the interest now excited by Mr. Sorby's announcement of the existence of jargonium will induce chemists to work the subject out in more detail.

ON THE

EXAMINATION OF WATER FOR ORGANIC MATTER.*

BY R. ANGUS SMITH, PH.D., F.R.S., &C.

In 1865 I received a request to write on the organic matter of water. I wrote a memoir, which was, without intending to be published, extensively circulated among officers of health, especially in India.

I there made a division which was entirely new to chemists. The substance styled "organic matter," instead of being given as one to which little or no definite meaning was attached, was considered as existing chemically under at least seven different headings, not forgetting the numerous organised forms which it might assume. These divisions were—

1st. The organic matter decomposed, or putrid.
2nd. Organic matter readily decomposed, and probably ready to become putrid.
3rd. Organic matter slow to decompose.
4th. Recent organic matter.
5th. Old organic matter.
6th. Vegetable organic matter.
7th. Animal organic matter.

The first was known by the gases which instantly decomposed permanganate.

The use of the permanganate of potash, recommended by Forchhammer for ascertaining the organic matter of water, has been tried and admired by some, and found entirely wanting by others.

I endeavoured to show, in the memoir alluded to and in a subsequent paper, how far that salt could be trusted; quite certain of its value for ascertaining bodies of the first and second classes, but having no experience of my own which would guide me to consider it a sufficient test for the total quantity of organic matter.

Bodies of the third class I was therefore inclined to estimate quantitatively by drying and weighing, afterwards ascertaining the condition of the matter as the point of most importance.

Organic matter of the fourth class was estimated by the amount of nitrites in the water, because their existence showed that the matter was oxidising, but had not had time to complete the action.

Bodies of the fifth class were estimated from the nitrates, as in that case the action was finished.

Bodies of the sixth class were reckoned from the absence of bodies of the seventh class, which latter class, again, were considered to exist when they were accompanied by an unusual amount of chlorides, supposing care to be taken to discover that other sources of chlorides did not exist.

It is not to be expected that any of these divisions should be sharply defined; but the one most difficult to decide upon, to all appearance, is really that which I have found, with proper precautions, scarcely ever to fail me, though it has been used in hundreds of instances, and for many years—namely, the test for animal matter.

Dr. Woods had written on the use of Forchhammer's chameleon previous to the publication alluded to, and about the same time Prof. W. A. Miller; but I am not aware that any one endeavoured to distinguish the various conditions of the organic matter. I am, and was, desirous of showing that organic matter is not necessarily hurtful; we speak of it in water as an evil, to be measured by the balance, whilst there is as much difference in the qualities of that found in water as there is between good wholesome meat and putrid flesh.

I was desirous also of showing the true value of the permanganate, which is capable of acting on one, but scarcely on the other, and of being used for analysis for sanitary purposes, although not for all the demands of the chemist.

Dr. Frankland next took up the subject, and proceeded to show the amount of organic matter, or of sewage matter, which might flow into a stream; and this he did by estimating the nitrogen gas obtainable from the organic matter of the water. By ascertaining the amounts existing in the water supplied to a town and flowing in the sewage, he found the total thrown out by the inhabitants.

For this he made an organic analysis of the residue of the water, and by a very beautiful arrangement, using Sprengel's pump, he drew out the nitrogen for measurement. I do not doubt that this mode adopted by Dr. Frankland will always be useful, and will remain permanent as a method, but not for constant use, on account of the time required, excepting by those chemists who perform many of such analyses, and have the apparatus in constant readiness. It is, however, always pleasant to find an addition made to our capacity for accuracy, and especially when such beautiful methods are employed.

By this means Dr. Frankland obtains the organic nitrogen, nitrates and ammonia being removable. I have not generally estimated the latter, as being

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations by the author.)

continued p. 140 + 268

more unstable than the former, and I have frequently found it to disappear with great rapidity, affording by no remnant any clue to the past. Urea and uric acid must also be excluded from the organic nitrogen before we obtain a clue to the albuminous matter. I think, however, that we require to know, above all, whether this matter is in a state to putrefy, or to produce living forms. If there are organic germs capable of development in a visible form, that condition ought not to be neglected.

Immediately, I believe, after this plan was adopted by Dr. Frankland, Mr. Wanklyn discovered a mode of decomposing albumen by permanganate of potash, obtaining ammonia.

This process was used by Messrs. Chapman and Miles Smith. I shall not attempt here to give the exact amount of honour due to those gentlemen, or to tell precisely the boundaries of their labour.

The result seems to be, that the nitrogen may be obtained without the trouble of the usual organic analysis, although it may be uncertain which process takes the longest time.

Mr. Wanklyn considers that he can, by his method, first remove the ammonia which exists as such, by boiling with carbonate of soda; next, by decomposing the albumen with permanganate of potash and boiling in caustic potash, obtain the ammonia resulting from the decomposition. This is a decided gain to us, and may turn out to be the normal mode of separating the ammonia of the putrescible and unputrescible organic bodies.

We are rather apt, when we find a method of analysis, to look at it as final. I shall endeavour to show how much we obtain by Dr. Frankland's method, and how much by Professor Wanklyn's. I shall perhaps, also, as in such cases, be inclined to show that my own method reveals a greater amount of the peculiarities of water. It makes more divisions, is more complicated therefore in one respect; but every point tells its own tale, and it is the number of tales we have to tell regarding the history of water that measures the fulness of our reports. I shall probably adopt all the methods for a time.

In the paper mentioned, I pointed out the error of supposing that organic matter was all equally unwholesome, or that it was, in all cases, even in the slightest degree so. It was the custom too much to confound the simplest peaty and the most noxious putrescible matter. On this subject I may here quote the paper.

"*Quality of the Organic Matter.*

"Water manifestly containing organised matter is to be avoided; but it may frequently be purified by some mechanical mode of separation, such as simple straining.

"If the water contains organic matter in solution, or a condition approaching in all appearance to solution, it may be wholesome or unwholesome. The mere existence of organic matter is no proof of impurity. We must know if it brings animalculæ or vegetable life or products of putrefaction. We must know the *quality* as well as the quantity. If the matter is peaty, consisting of the ordinary humous class of acids and salts, the colour may be very dark and the water very unpleasant to look at, without being in any way, so far as I have ever heard, injurious to health, although such water cannot be quite so wholesome as pure water, since the oxygen of solution is diminished. The taste and other sensible qualities will be the chief guides.

"If the matter is wholly or nearly colourless, it may still be wholesome or unwholesome. It may, for example, contain the juices of plants of a wholesome character. If these juices are fresh, they may do no injury; but they will not long remain fresh, they will putrefy. Water containing organic matter ready to putrefy ought to be avoided, as we cannot tell when the moment of danger begins; whilst the quality at best is never known to us exactly.

"To ascertain the nature of the organic matter, the water is allowed to stand for a day or two, in which case it may be found that organised bodies show themselves.

"Sometimes plants seem completely to fill the vessel, having come out of a moderately clear solution. When standing, in this case, the water must be prevented from evaporating, and it must be in glass, so as to be exposed to light; a temperature suiting vegetation is also to be given. Animalculæ may appear in great numbers; they are an indication of nitrogenous matter, and one proof of the presence of substances capable of putrefaction. It may be that some form of putrefaction will be the only result; but whether this occurs alone, or along with organised forms, an excess of organic matter is proved.

"Water that will not bear the test of standing will in most cases be rejected at once. If no other can be obtained, it ought to be used before the putrefactive process has begun; but this is very dangerous. The next best method is to wait till after putrefaction has terminated, and the products are separated as much as possible. This is popularly known to be the case when the water has for some time become clear and colourless, and free from smell and taste. There are some difficulties connected with this. Water undergoing putrefaction is manifestly unwholesome. After putrefaction is completed, it may be quite wholesome. Although the process is proved by Pasteur not to begin without the aid of organic germs of some kind, they seem to be of a class constantly existing in the atmosphere, even when it is wholesome, whilst we have reason to believe, from the results, that germs of disease, if there are such, are decomposed, like other albumenoid substances, during the action. It would, therefore, be probably safer to wait till putrefaction was completed, but this is often tedious. At any rate, it was intended to state that, when activity began, it was not safe to use the water. The points of safety and of danger require investigation.

"Water with green organic matter in suspension or semi-solution is generally full of germs of living things, and nauseous to the taste.

"A microscope is very useful in detecting the smaller forms of life, but not always essential. Good water is clear and colourless, or only slightly browned by peat. Clear bright water shows no microscopic objects. It is quite a mistake to suppose that all water contains animalculæ. Those who have sent abroad this saying could not have known what pure water is.

"If the signs of organic matter are clear, it may not be needful to go further, but to reject the water at once. After standing for two or three days, varying with temperature, and showing nothing to the eye except a little film of green on the bottom of the vessel, we may conclude that not much organisable matter is there. We may then proceed to the chemical examination."

Some years ago it was customary, more than now, to examine with the microscope water intended for the

use of towns. Attempting at one time to join the chemical and microscopic together, as they were too much in separate hands, I came to certain general conclusions:—That no ordinary pure water produced much vegetable or animal life, and that microscopists were mistaken in allowing people to suppose that every drop of water was inhabited; that nevertheless water, generally considered very pure for drinking, might contain some forms not possessed with distinct locomotion; that whenever distinct locomotion began, especially among soft-bodied forms, the water was more than suspicious; that forms increased with the quantity of organic matter containing nitrogen, until the amount was so great as to cause gases of decomposition which eventually stifled life. How far this stifling of life proceeds I do not attempt to say. I suppose it will not apply to the mucedines, which cause putrefaction to commence.

If the water was impregnated with sewage water (as the Thames at London, for example), bad cases excepted, the amount of vegetation which spread over the sides of a bottle filled with it and set in the sun, was so great as to give the appearance of one solid mass. If the water were taken from the river above Reading, the amount of vegetable matter was seen as a delicate green colouring at the bottom of the vessel; and if it were taken up at the source, no greenness whatever appeared, but, after long standing, minute crystals of limestone. If the water contained sewage, the phosphates and magnesia were generally found collected in some form of the *Navicula*, frequently in large groups of the *Navicula fulva*, and with it also was found phosphoric acid and magnesia. It was sufficient to note the condition of the water with relation to these deposits to ascertain at what part of the Thames the specimen was taken; and without the examination of these deposits, I do not consider that it would have been possible to obtain a distinct idea of the nature of the organic matter present. It is, however, needful that we know the general character of the water; had we a specimen from another situation and found no deposit whatever, it would have been very unfair or very unwise to conclude that it was similar in quality to that from the source of the Thames. It might have been saturated with nitrates, and even a large amount of organic matter not capable of taking the forms alluded to. Perhaps, however, nitrates prevent decay in water as in meat. As the germs of the lower forms of life may pass by us unobserved, it is necessary that we should give them time for development, in order that they may become sufficiently prominent to attract our attention. For this reason I consider it an imperfect examination of water when this is not attended to, in cases at least where we have not the slightest idea of the nature of the water. We find water with less than two grains of organic matter per gallon giving rise to forms by no means agreeable to look at in our food, and water with several grains of organic matter giving rise to no such forms.

It is true that we cannot tell which of these living forms are most dangerous; we cannot tell which of them, if any of them, produce either cholera or any other disease; but we can say that water which contains them may contain the elements of disease, whilst water which does not contain them or matter to make them is innocent. So far as this we are obliged to go at present. It was for these reasons that I have not recommended the method of estimating the total nitrogen in water. I was inclined to believe that the danger arising from water could not be measured by the amount of organic matter, or even by the amount of nitrogen in the organic matter.

Still it is of advantage to estimate the nitrogen of the organic matter, in order to compare the state of one source of water from day to day, as, for example, Dr. Frankland does so frequently in the case of the Thames. It is not, however, the organic matter only that gives out nitrogen; that is given out by ammonia and nitric acid; and these must also be estimated when seeking albumenoids. And this course is adopted by Profs. Frankland and Wanklyn.

We may now inquire how far all these bodies together will give us the amount of the organic matter falling into the water.

When azotised compounds decompose and form ammonia, how long is this ammonia retained in the water? On examining a very putrid stream, I estimated the amount of ammonia at the most putrid portion, where carburetted hydrogen was passing off in great volumes, and where a cubic foot could be obtained in a very few minutes by stirring.

In the sewage stream of which I have spoken, the amount of ammonia was from 0·5 to 0·7 grain per gallon. After going 14 miles, the amount was only 0·07, and, after 20 miles, none at all was found. To say none at all, is to go far, but it was not found by the mode adopted for the others.

The mud of the same stream was in a state of putrefaction, and contained, per cent—

Ammonia	0·797
" a mile lower	0·420
" at second mile	0·171

The ammonia rapidly disappeared, and the mud itself diminished very greatly in amount.

I estimated that one grain of ammonia evaporated, in some seasons, from every square foot per hour.

In taking sewage water to the land, I think it very important that the movement should be as rapid as possible.

The water, in its passage of 20 miles, has lost its valuable ammonia, and that within two or three days. This is a sufficient proof that we must not trust to the ammonia as an indication of the amount of the organic matter which has been present, as it is as rapidly removed as the organic matter is decomposed; that is to say, the length of time necessary for complete putrefaction is, under favorable circumstances, no greater than the time afterwards required for the removal of its products. In enquiries on putrefaction, I have found the temperature 12·2° C. a marked one. Putrefaction may be said to begin actively at that point, and the results here given would, probably, be very different below that. In this water there was no moving life to be observed; but the estimation of the organic matter would have shown no difference, whether vitality had been present, and the substance had been capable of entering into active and unwholesome forms, or had been ready to break up into instantaneous putrefaction, or had been preserved, like a mummy, in carbolic acid for a thousand years.

From this observation regarding the ammonia, we are clearly led to beware, in our schemes of irrigation by sewage water, that the land shall be overflowed before the ammonia is thoroughly formed, or else, if the ammonia is formed, that it shall not be subjected to loss by long exposure to evaporation.

We see, also, that nature provides here for

plete obliteration of organic matter. It ceases altogether to be found in the water. It may be traced, either as such, or as ammonia and carbonic acid, long after the bubbles of carburetted hydrogen have ceased to appear, until, at last, it dwindles down to an amount which is rather difficult to remove from water, and which, so far as we know, may be utterly disregarded.

In the passage of organic matter, we may observe, from figures soon to be quoted, that the volatile and organic matter diminished from 9·33 grains per gallon down to 5·04, even when there was an increase of fixed matter, and that the decomposing matter in solution diminished still more rapidly, in the ratio of 283 to 17. The use of the word decomposing matter is not quite correct; it means the substances in solution, arising from decomposing matter and absorbing oxygen at once. It must be observed that the time required was two or three days; and I may add that I could not have drunk the water at last, but there was great foulness to begin with. Still, it shows great removal of impurity.

The organic matter having left the water, we may next inquire whether any trace of its existence remains behind. That trace we do find in the increased amount of alkalies, sulphates, and chlorides.

The alkalies and alkaline salts, but especially common salt, are prominent. The whole of the common salt which has been used as food, without the slightest loss, is found in water, when vegetation has not removed it. The sulphur has become partly oxidised, leaving sulphates, whilst some may have left in company with hydrogen. Phosphates have been increased for a time; but they rapidly fall, taking lime and some magnesia with them; and, on the whole, the great change to be observed in the water is connected chiefly with the alkaline salts. The most stable and most constant of these, without loss, is common salt.

On this subject, I may quote what has been said elsewhere regarding the chlorides as an indication of the presence of animal matter, proper regard being had to the absence of other sources, which, in this country, are chiefly connected with artificial circumstances. "The absence of the chlorides, especially, may be considered as the certain absence of sewage matter, and their amount to be estimated as an indication of the comparative amount of sewage matter from day to day, in cases where sewage only pollutes the river." I conclude from these data that the organic matter and the nitrogen in it are equally incapable of giving us a sufficient history of the water. We may draw another conclusion, that nature has provided a mode in certain conditions for its perfect removal.

It is worth while to ask whether this purification by putrefaction is not the most complete method; it seems to destroy that which we consider to be germs, which germs may be a beginning of any disease of the most terrible form. Having read most that I can find on this subject, I have been led to think that the water, before and during putrefaction, may contain the diseases that have been washed from cities, but that the air above, containing the gases and vapours, does not contain the germs of these diseases, although, of itself, it is extremely loathsome and decidedly unwholesome. It is rapidly purified by the atmosphere. However, I reason from the facts obtained by others, since disease is not my study. After complete putrefaction and clearing, the water seems to be used with impunity. Our rivers, however, seem too small to *purify* large quantities in their course, as even in warm weather, the time must be measured by days if the specimen given is a fair one. I do not pretend to say how much may be allowed to go into a river of a given size without fear, but this may be found, as, after all, every river has some sewage from animals, and, in this country, even from man also.

If the water were allowed to clear itself by standing, producing whatever amount of organic life could be developed from it, the germs might be increased in number, instead of being diminished. It is proper to observe that the liquids must be included. The solids contain little chlorine. The water above might remain very clear, but might be, nevertheless, very dangerous. In such a condition, water seems to be best purified by filtration through the soil, which simply means extremely slow and careful filtration, accompanied with partial oxidation; in that case, the water coming from under the soil would be fit again for use, although it would contain, and does contain, the alkaline salts alluded to.

Waters from rich lands, unless from very deep drains, always contain more organic matter than water from hills, and more albumen, or matter so conditioned that it is capable of assuming a great variety of living forms with and without locomotion. Water from the hills of Scotland and Wales, Cumberland, and many parts of North England, gives rise to no variety of living forms; and, in many of them, there is scarcely anything to be remarked in the deposit, unless opportunity is given for collecting it from a large quantity of water, and concentrating. On studying this subject many years ago, I found that, in some of those cases where the water was peaty, there was also to be found a large amount of ammonia. The words I used were these:—"In a peat bog which is not well drained, and is, therefore, wet and cold, the acids of the peat do not become dissolved so as to form a very deeply coloured solution, but they form a solution of a pale yellow. But in grounds which are warmer, or, what is better, well drained, the amount of soluble matter is very great. The colour of such water is not to be confounded with the water which heavy showers bring down, filled with mud and bits of peat; it is often perfectly clear and bright, but brown like coffee. The acids in solution at such times are kept so by the presence of ammonia. Ammonia dissolves them in large quantities, and along with them also the salts which they form with lime, magnesia, soda, phosphates, &c.

"Plants begin to grow in warm weather; at this time ammonia is formed. It is at this time the organic matter decays, and, in its approach to inorganic matter, passes through this stage of ammonia.

"The peat mould Mulder has shown, but he has not mentioned this excess of ammonia."

I supposed at the time, as it appears, that the ammonia produced by the decomposition of vegetable substances was used for the solution of the ammoniacal humates of Mulder. The paper read was only a short note intended to call attention to an important and curious point—the amount of ammonia on those bare hills. I have had the subject before me frequently since that period, namely, 1847, but have never given it all the time required for its elucidation. Lately, Professor Wanklyn and Messrs. Miles Smith and Chapman have examined the hill-waters, and have rather alarmed the public by informing them that they contain more albumenoid matter than waters coming from rich plains. The process they adopted has, no doubt, shown two conditions of the nitrogen; and it is pos-

sible that one may be albumen; but it seems perfectly clear that it is not putrescible albumen. I had long ago found the nitrogen; it still remains to find out all the conditions of its existence. If waters containing nitrogen from the hills are allowed to stand, they neither show their nitrogen by the production of living forms in proportion to the amount of that element, nor by putrefaction; any fear, therefore, of such results may be entirely put out of our minds. The living forms, which are the most dangerous, are fewer than from pretty deeply filtered water of the plains; and putrefaction cannot exist when the matter to putrefy is so minute: when the solutions are extremely weak, oxidation overpowers it. Such, at least, is my experience.

A reason for believing that nitrogen exists as albumen is the large amount of fish which the water supports. But protein exists in many conditions. The learned originator of the word had the idea of the prophetical and changeable Proteus in his view, as well as the rank of the substance as first in importance, because it forms man. I think, however, the probability is that the earth acids keep it from change, united to the generally low temperature on the hills. This latter, however, does not seem needful. These soils saturated with peaty water are not to be compared to flat, wet, and ague-bringing grass and other lands. I find the process of Professor Wanklyn still more valuable since I wrote the above, although I adhere to the reasoning that, although he may be right in believing albumenoids to be present, the water is not, to that extent, hurtful. The same applies to the reasoning, as I understand it, of Dr. Frankland. But we need not quarrel; it is enough if we each try to elucidate the subject.

Let us now consider what does take place during putrefaction. In all cases known to me, the first thing that occurs is the diminution of oxygen in the air absorbed by the water, and, to a more or less extent, the production of sulphuretted hydrogen, which, however, may exist in the water to a very small extent at a time, being rapidly converted into combined sulphuric acid when oxygen can be found for the purpose.

In Loch-Katrine water, the oxygen found in the absorbed air, by Dr. Penny, was equal to 31·69 per cent; that of the Manchester water is equal to 27 per cent. In the Liverpool water, at the bottom of the reservoir, the amount fell to 12 per cent, being equal on the surface to the Manchester. In the first case, as well as in the second and similar cases, the amount of oxygen is too great to allow of putrefaction; and in the third case it was very clear that the oxidation was a process of decolourisation, at least in part, whatever else may have occurred. This decolourisation is caused by the oxidation of the *humus* and its removal as carbonic or other acid.

The gases of pure water contain nearly 34 per cent of oxygen.

Dalton found cistern-water almost entirely deprived of its oxygen; and I have found every percentage of oxygen from 34 downwards.

I go further into this point in my chapters on water, which I hope to bring out soon. Meantime I may say that the examination for oxygen is a very important one.

Another important feature in putrefaction is the occurrence of carburetted hydrogen. The carbonaceous or organic compound, having lost the ties that bound it together, is broken up into fragments. The carbon, when it can find oxygen, goes off in its company, but otherwise it leaves with hydrogen; separate, however, it must, and that with considerable violence. When there is a great amount of oxygen these decompositions of organic matter do not take place; and even if the Loch-Katrine and other water were largely supplied with organic matter, putrefaction would be entirely absent, as it now is, as long as the high amount of oxygen was kept up in continual presence.

That organic matter does exist in peaty water to a larger extent than in streams not peaty, but still offensive, may be taken for granted. A very brown water contains about four grains per gallon. It is extremely dark, indeed, if there are six grains; but, without peat, putrefaction, or, what is still worse, the development of mischievous germs, may occur, whilst in the other they seem stifled. How far this disinfecting and preserving quality of peaty matter will act in weak solutions I cannot tell; but in its greatest strength (that is, surrounded by the matter of the peat itself), preservation may exist for an indefinite time; and the non-occurrence of putrefaction in weaker solutions may be considered sufficient to show that there is abundant antiseptic power for the amount of matter to be preserved in these waters.

But the question still arises, what is this organic matter containing nitrogen? If it is albumen it is disinfected, if the peat is great in amount; and it is incapable of putrefaction, if the oxygen is great.

We are not perfectly sure that these ammoniacal humates of Mulder's actually exist in the form he mentions. It may be that the nitrogen is otherwise combined, giving another mode of explaining the conditions of the water. If they are combined, as Mulder believes, we have only to allow oxygen to enter the brown water and be absorbed, a process which readily occurs; the *humus* is bleached, and the ammonia is free to combine with carbonic acid, and readily to dissolve a fresh portion of the same salts of which it formed a part. If the nitrogen be otherwise combined, whether as albumen or any similar substance, the oxygen will still play a corresponding part.

By this view of the subject, the brown waters would be giving off carbonic acid, freeing and losing some carbonate of ammonia. When oxidation takes place, a certain acidity is found, coupled with a little bitterness, a quality possessed by great portions of the waters of the hills. This, I believe, occurs in those waters which have not been purified by descending deep into the earth (where thorough oxidation and sweetening take place), but which have passed only over the surface, and been partially oxidised. The complete oxidation produces carbonic acid; the restricted oxidation an acid that is not volatile, and is extremely bitter. I have prepared so little of this, that I am unable to give a good account of it. It was formed from extremely brown water, chiefly from the river Avon, in Lanarkshire. By its formation, the water became very bright; when boiled down, the acid became stronger to ordinary tests, and its bitterness became more intense.

I may remark, by the way, that in all the bottles in which this occurred there was a deposit of very fine flakes of silica, leading me to think that, by our usual modes of estimating that substance, we were apt to make the amount too small. I believe this acid to be the origin of that bitterness which I have so often observed on the hills; and even in the very
from the hills, the two processes have
the same time—the formation of carbo
formation of the non-volatile acid.

[English Edition, Vol. XIX., No. 497, pages 281, 282; No. 499, page 304.]

... when ... as usual; ... a greater ... for many years, ... be hurtful to ... year, accident- ... who told me of some ... much inconvenienced ... of spring water with ... they had found the ... I am not aware that this ... than elsewhere; ... the substance in it, to which ... to those who have ... it.

... observable in water from the ... west of Scotland, at least in some ... also in Loch-Katrine water, although ... mentioned.

... I was inclined to believe that the ... was owing to these salts, until I found it ... oxidation. I am not prepared, however, ... they are incapable of modifying the taste, ... they exist in quantities very minute.

... this view of the case, water collected in the ... is very different from that which has run ... the plains. The age of the water also is a ... of importance, and if kept long in deep reservoirs ... in shallow reservoirs.

If in shallow reservoirs, the water may be uniform throughout; if in deep reservoirs, the oxygen may never be able to permeate to the bottom. At a depth of twenty feet I have found more than twice as much organic matter than was to be found on the surface, whilst the lower specimen was of a much deeper brown. This was in the Rivington reservoirs, as already said.

Water that comes down very rapidly may never be able, in a practical period, to have the organic matter thoroughly oxidised. Water which purls down rather slowly, falling, nevertheless, over many rocks, is always clearer, although the reason partly of this is, that such water is not surface only, but has drained through the soil.

Peat itself, if distilled with fixed alkalies, gives out ammonia. I suppose there is no doubt that some of this arises from the decay of vegetable albumen, some of which may be retained in the peat; but its mode of decomposition is still a problem; it seems to take place chiefly by oxidation, not putrefaction. I was inclined to think that a notable amount of the ammonia might be taken by the acid waters direct from the atmosphere.

But the smoke of peat, or rather the oily matter deposited by the smoke, contains nitrogen compounds, very probably the bases obtained by the decomposition of that vegetable albumen, which will not enter into fermentation, or expand itself into the lower and dreaded organised forms, although compelled to yield to the action of fire. This shows that all the nitrogen does not exist as ammonia. Although Mulder is highly to be honoured for the work performed in endeavouring to elucidate the subject, and especially the question relating to *humus*, it is not easy to agree with him. If, however, any one would begin where he has left uncertainty some reward would be found.

I give a few quotations from Mulder's "Physiological Chemistry," first German edition:—

"I repeat that the ammonia in the soil, as in the natural saltpetre-grottos of Ceylon, is formed from the atmospheric air, the oxygen of which, instead of forming nitric acid, changes the organic substances into ulmic acid, then into humic acid, geic acid, apocrenic acid, and into crenic acid.

P. 158. "This formation of ammonia from the constituents of the air and water is of the highest importance for the growth and success of the plant. It is the cause which converts the insoluble organic constituents of the soil into soluble substances, and thus presents them to plants as organic food, even when no ammoniacal manures are added besides to convert the five mentioned acids into soluble salts of ammonia."

P. 166. "Ulmic, humic, and geic acids, however formed, possess the power of absorbing ammonia and water to the extent of several per cent. The quantity given out (at 140°C.) is between 8 and 16 per cent. It requires 195° to free them from water."

P. 167. "The power of ulmic, humic, and geic acids to condense ammonia is so strong, that the acid made by acting on sugar with hydrochloric acid almost always contains ammonia if air is not kept away."

P. 169. "These acids combine so intimately with ammonia, that they have the character of an organic compound of four elements; by treatment with potash at a higher temperature they lose the ammonia completely."

In the "Handwörterbuch der Chemie," under "Humus," it is said that by constant digestion with hydrochloric acid, ammonia was not removed. It is also added that, boiled with an alkali, the ammonia is not removed.

This accounts for the opinion held by Berzelius and others, that nitrogen existed in these earth acids; and certainly it is not clearly shown that they are only ammoniacal salts.

Berzelius gives Hermann's old analysis of crenic acid as containing nitrogen; and until we can finally settle the composition of these substances, we may be allowed to doubt. Whatever the compound be which contains nitrogen, its disinclination to putrefy must lead us to believe that even the organic nitrogen is not a measure of the dangerous quality of water, whether that nitrogen exist in a non-putrescent condition or association of the albumen, or in a substance removed a step from albumen and passing downwards to a condition more allied to the idea of an inorganic body. My own belief is that part of the ammonia is in combination with earth acids, and part of that which we find is obtained by destroying an albuminous substance rendered non-putrescible by its surroundings.

I have given my reasons for believing that neither the nitrogen of ammonia nor the other nitrogen found in peaty water can be taken as the indication of the amount of putrescible matter. At present, I believe, we have no idea of the actual relation in which it stands to health. It will be interesting to know now if the nitrogen of the nitrates and nitrites is at all similar. These salts are not formed when putrefaction is going on rapidly. The reason is very simple: the water is then deprived of its oxygen. We do not know all the conditions of the formation of these salts; but one is essential, that oxygen shall be present.

In the Thames water, at least two miles below and above Hungerford, there was nitric acid in considerable abundance in 1848. It is mentioned, in evidence given in a parliamentary inquiry twenty years before that, that red fumes rose on heating the deposit. I quote from memory.

In 1848 this was certainly the case. In later analyses, by Dr. Hofmann, the nitric acid was not

mentioned. I considered this at the time a mistake; and I examined the water again, finding, however, extremely little nitric acid, and, I believe, in some cases none.

Having examined other putrid streams, and found no nitric acid, I conclude that it had disappeared from the Thames also when it became more impure than previously.

During the time that river was so offensive near the Houses of Parliament, the organic matter must have wholly, or nearly deprived of its oxygen the air in solution. Running streams, however, do not, so far as I know, contain much nitric acid; that substance is formed in greatest quantity by the action of porous bodies. The oxidation is assisted by the pressure to which the gas is exposed by being brought in contact with a great amount of surface, as well as of numerous surfaces contributing to the result. For these reason snitrates are found best in soils through which azotised matter in solution is slowly passed.

I had occasion to make experiments on this point, and showed, in a paper to British Association, in 1848, that a filter might be made to form nitrates from putrid matter.

An interesting question arises—Does the nitric acid indicate the amount of organic matter which was previously in solution?

If nitrates are put on land, they are decomposed by vegetation, and the nitrogen is retained. These salts act both as food and air to plants. The water which flows from drained land may contain nitrates, but they are not a measure of the amount put on the land; and if they result from the organic matter there, they are still not in proportion to its amount, as, even after they are formed from vegetation, they may be decomposed by it.

Nitrogen, therefore, may be removed from water either as ammonia, or organic matter, or nitric acid, every trace of it finally disappearing. Those nitrates, however, which do remain indicate that at least an equivalent of albuminous matter or sewage matter did exist.

Another interesting question occurs—Is the nitric acid removed without vegetation? I believe that it is so.

In water from drained fields vegetation is generally found, though frequently in very small quantities. In the soil around drains it is found in considerable quantities; but after putrefaction has occurred in the Medlock, at Manchester, I have not found it. The oxygen seems to be removed as the oxygen of the air is, probably leaving nitrogen to pass off as gas.

As the nitric acid indicates an equivalent of albumen, I have put it down as telling us of the previous presence of organic matter; in other words, of old organic matter. The word "old" has no relation to time, except so far as to mean older than that from which the nitrites are formed, and the original organic matter. The nitrites, not being fully oxidised, are supposed to be in the process of becoming nitrates. They have been taken, therefore, as indicating recent organic matter,—the word "recent" meaning only that they stand between the organic matter and the nitrates. I do not know that nitrates are converted into nitrites in water. Still it may be found to be so.

It may be asked,—If the nitrates are not a proof of albuminous matter, whence do they come? If it is said from the air, as Mulder would bring them, we need a proof; if from ancient remains, we need a proof; but we need no proof that they can come from albuminous substances. I believe they come from both animal and vegetable matter, so that decomposing roots and plants will send out some; but animal matter is the richest source. We have animal sewage and vegetable sewage. The latter is capable, as is well known, of doing much evil—perhaps not so much as the former, although this is uncertain. It does not seem proved that grass itself will not give nitrates. Yeast produces them. If vegetable and animal albumen are equally bad, we need not care as to the distinction of source; if nearly equal, we may care but little.

In looking for organic matter, I think it quite unsafe to trust either to chemistry or the microscope, without giving time for the development of all possible germs; but this is a point which demands a good deal of inquiry. Microscopists have given us details of appearances; but these have not been sufficiently classed; and the conclusions drawn have, therefore, not been valuable to the desired extent. To trust to the microscope without time for development, is to believe that the germs of disease can be seen. The use of allowing water to stand is not that the germs of disease may be seen, as we do not know them if we see them, but to see if the matter is active. The value of this must be tested.

The loss of the oxygen with peaty matter and no vegetation indicates, as already said, the formation of carbonic or bitter acid. The loss of oxygen with the evolution of sulphuretted hydrogen indicates putrefaction; but there are two conditions which externally resemble each other very much, namely, the growth of vegetable matter with diminished oxygen, and the growth of vegetable matter with excess of oxygen. Water in the first of these conditions, too, may contain, as I imagine, the most dangerous ingredients: germs of all diseases may exist in such waters; we do not know to what extent; and, as we are very ignorant on the subject, it is well to be alarmed at the conditions, until we have examined them and made distinctions.

We do not know very much about the second of the two; and if I think it less dangerous, it is perhaps more from a prejudice in favour of the abundance of vital air, and of those hill-waters which do not contain bitter peat than from any accurate knowledge which has been attained.

Weighing the Organic Matter.

If nothing apparently organic is seen, or if there be no time to allow it to germinate, we may try the following method: About half a gallon of water is boiled down in a platinum vessel; or if there are no soluble carbonates it may be boiled in porcelain and transferred with care, when only a few ounces are left, to a platinum or even to a small porcelain capsule. The residue is dried and weighed. It is then burnt so as to oxidise the carbon, and weighed again; the difference gives the organic and volatile matter of the residue. 212° F., or 100° C., is not sufficient to remove all water; but as it is a temperature so easily obtained, it is convenient to consider it enough, especially as we cannot obtain the organic matter by weighing with absolute exactness. We may obtain an excess of water by the use of 212°, on one side; but, again, organic matter begins to be given off from some residues at that temperature; Professor Miller and about 300° F. It is, at any rate, temperature in the account of the

peratures appear to me wrong, and so is every other I can think of. The results, however, of this method are very useful.

The burning must not be effected at a very high heat, or several salts will be decompo ed or evaporated; but at best some will suffer; and the use of a little carbonic acid and water, or carbonate of ammonia, to restore the lost amount, is advisable. A little distilled water and a few expirations into it through a glass tube will be sufficient for most cases; of course after this the ash must be heated again.

Professor Miller advises the addition of 0·3 gramme of carbonate of soda to a litre of water, or 20 to 25 grains to a gallon, making allowances in the weighing.

It is needless to remark that I consider Frankland's mode of obtaining carbon and nitrogen far superior to any weighing, when hands sufficiently delicate are found. By using larger quantities, there seems no reason for supposing that the process cannot be undertaken by men who cannot advance beyond average refinement of touch. Since this paper was read, about a year and a half ago, the Wanklyn process for nitrogen has been gaining favour in my laboratory, as the results obtained have been very constant.

(To be continued.)

ON THE PROXIMATE ANALYSIS OF COALS.*

BY PROF. GUSTAVUS HINRICHS,
CHEMIST OF THE GEOLOGICAL SURVEY OF IOWA.

Determination of the Moisture.

A flat-bottomed iron pan, of 20 centimetres in diameter, was filled evenly to the depth of 1½ centimetres with sand, and the latter was covered with a copper plate, on which the watch glass containing the coal was placed. A thermometer (scale to 370° C.) was, by means of a rubber stopper, inserted in an iron arm of the tripod supporting the iron pan, and held with its bulb about half a centimetre above the copper plate. By means of a Bunsen burner it was found very easy to keep the thermometer perfectly constant at 115° C. This apparatus I consider a good substitute for Fresenius's iron plate.

The coal to be dried was finely pulverised, direct experiments having convinced me that the application of fragments was not only very much slower, but also erroneous, on account of the peculiar property of bituminous coal treated of below.

In order to show the accuracy of this method, I transcribe the following examples from my journals:—

No. of Coal.	Weight of Portion.	Time.	Moisture. Per cent.	Moisture. Deviation from Mean.	Mean.
390 e	0·961	1 hour	4·888	—0·004	4·892
" f	0·919	1 "	4·896	+0·004	"
" e	0·961	2½ "	4·160	+0·010	4·150
" f	0·919	2½ "	4·140	—0·010	"
339 e	1·452	1 "	8·260	+0·070	8·190
" f	0·975	1 "	8·120	—0·070	"
" e	1·452	3 "	7·160	+0·170	"
" f	0·975	3 "	6·830	—0·160	"
338 e	1·415	1 "	3·852	—0·029	3·881
" f	0·805	1 "	3·911	+0·030	"
" e	1·415	2½ "	3·287	+0·123	3·164
" f	0·805	2½ "	3·042	—0·122	"
" e	1·415	5½ "	2·722	+0·088	2·634
" f	0·805	5½ "	2·546	—0·088	"

* Communicated by the author. For a previous paper on this subject see, also, vol. xviii., p. 53. (*Am. Repr., Sept.* 1868, *p.* 143.)

These results—a few taken from among a great number of determinations—show that the loss (called moisture) decreases regularly after the first hour of drying, that is to say, while the coal loses in weight during the first hour, it steadily gains in weight thereafter. It appears, furthermore, that the accuracy of a determination, expressed in the smallness of the deviations from the mean, is greatest at the end of the first hour of drying, least after about three hours of drying, and thereafter increases again, as expressed in the diminution of the deviat ons after 5½ hours' drying in coal No. 338.

On account of these peculiar properties of our bituminous coal, I put down as *moisture* the loss in weight of the finely-pulverised coal after one hour's drying at a temperature between 105° and 110° C.

On the Slow Oxidation of Coal.

This increase in weight after the first hour's drying I have found in all Iowa investigated as yet. I have also found it to occur in a sample of coal (Steinkohle) from Benthen, Silesia, which showed a loss of 3·62 per cent at the close of 1 hour, and in 4 further hours' drying gained again 0·42 per cent. It was not noticed in brown coal from Bilin, Bohemia, nor in anthracite from Pennsylvania. I am, therefore, inclined to believe this to be a property peculiar to pit-coal (steinkohle).

On page 401 of vol. I, p. I, of the "Iowa Geology," Professor Whitney remarks: "A remarkable fact in connection with the determination of the water present in the specimens of coal has been noticed. In numerous instances, after the sample, in the form of a coarse powder, had been dried for several hours in the air bath, at a temperature a little above that of boiling water, during which time it had gradually lost weight until all the water seemed to have been expelled, on continuing the operation for some time longer, a slight increase of weight would become perceptible, and the coal would continue to grow heavier, until a gain of several tenths of a per cent of the original weight had been made. This appears to be owing to the slow oxidation of the sulphur which all these coals contain in a finely divided state, disseminated in invisible particles through the mass, and, perhaps, partly in combination with iron."

It is evident that Professor Whitney failed to discover this property as a general one, because he had the coal in coarse fragments. The want of correspondence in the results of determinations of moisture in the same sample, dried at the same time, but of different weights, made me apply the coal in the form of powder. Thereby the turning point was reduced from "several hours" to less than one hour, the "numerous instances" extended to all samples investigated, the "slight increase of several tenths of 1 per cent" became often 2 and even 4 per cent! Instead numerous exceptions we now discovered a general law.

We have failed, as yet, to notice any "sulphur" disseminated through the Iowa coal; what popularly is called sulphur is pyrites. Professor Whitney has given no proof of the excistence of real "sulphur" in the coal. It is, therefore, unsatisfactory to ascribe this property of the bituminous coals to such "sulphur."

Pyrites might well be the cause of this phenomenon; the red ashes obtained in many cases (in Van Buren county, Iowa, invariably from the upper part of the coal bank) may well be ascribed to pyrites disseminated through the coal in invisible particles. Two FeS_2 will give $Fe_2O_3 + 4SO_2$ by exactly doubling th ir weight.

In order to decide the question, I select the following results from my analyses:—

INFLUENCE OF TIME OF DRYING.

Top coal.....	No. of samples,	4	3	2
	Time of drying,	2	3	4—5 hours.
	Mean gain, p. c.,	0·45	0·71	0·96
Bottom coal.....	No. of samples,	3	5	2
	Time of drying,	2	3	4 hours.
	Gain, per cent,	0·49	0·50	0·96
Mean of above...	No. of samples,	7	8	4
	Time of drying	2	3	4—5 hours.
	Gain, per cent,	0·46	0·63	0 96
	Gain, per hour,	0·23	0·21	0·24

or, on the whole, for 19 samples of coal, very nearly proportional to the time, this being not more than four hours. It also appears that no essential difference is apparent in regard to the position of the sample in the coal bank.

By this means we may compare the following determinations, referring to two, three, or four hours drying. We find:—

Coal. Place—No.	Time, hours.	Increase, Total.	Per ct. per hr.	Difference.	Colour of Ashes.
top 390	2	0·75	0·38		pale brown.
				0·22	
bottom 384	2	0·35	0·16		white
bottom 395	4	0·80	0·20		red and white.
				0·04	
top 375	4	0·64	0·16		white
top 346	3	0·68	0·23		reddish brown.
				0·08	
bottom 371	3	0·45	0·15		white.
top 336	3	0·76	0·25		gray.
				0·06	
bottom 334	3	0·58	0·19		gray.
top 333	3	1·17	0·39		pink.
				0·09	
bottom 340	3	0·91	0·30		light gray
middle 357	3	0·55	0·18		white
				0·03	
top 370	3	0·46	0·15		reddish.

Except in the coal from the last mine, we notice that the more ferruginous ash does correspond to a slightly greater increase in weight; but we notice also that this difference is but very small as compared to the total amount of increase, being only 1-5 to 1-3 of the whole. Arranging these coals in the order of this hourly increase, we find the colour of the ashes not at all forming a regular series from white to red, as it ought to be, if this increase was mainly depending upon the oxidation of the pyrites. Besides, the mean of the four white ash coals is 0·16 per cent hourly increase, while the mean of the four coals showing the greatest increase is only 0·33 per cent, or double the former.

Coal.	Increase, per cent.	Ash.
333	0·39	pink.
390	0·38	pale brown.
340	0·30	light gray.
336	0·25	gray.
346	0·23	reddish brown.
395	0 20	red and white.
334	0·19	gray.
357	0·18	white.
375	0·16	white
384	0·16	white.
371	0·15	white.
370	0·15	reddish.

The greater increase of the pyritiferous coals is accounted for by the oxidation of the pyrites they contain; the comparatively great increase of coals giving a pure white ash seems to force the conclusion upon us that the bitumen of the coal itself oxidises, and that to this oxidation the main increase of all these bituminous coals must be ascribed. Remembering, now, our result regarding the deportment of bituminous coal from Silesia, anthracite from Pennsylvania, brown coal from Bohemia (all of which gave ashes very nearly of same shade, and all of which had been in my air-heated laboratory for two years), it seems not unlikely that this is another characteristic chemical difference between bituminons coals and other fossil coals.

In conclusion, I will give only two additional determinations, showing a very considerable increase in weight, and also that the process of oxidation is completed in about six hours for two-thirds grammes of coal. For No. 329, containing 8·30 per cent of grey ashes, gained in 5½ hours 2·05 per cent of its original weight. Coal No. 348, with 6 per cent red ashes, weighed 0·693.

			Change. Weight. Per cent.	Total loss. Per cent.
After ½	hours,	0·630	loss 0·063—9 091	9·091
" 2	"	0·625	" 0·005—0·722	9 813
" 5½	"	0 656	gain 0·031—4·474	5·339
" 8½	"	0·656	" 0·000	5·330

DETERMINATION OF THE ASHES.

The best way to determine the ashes in coal I found to be the coking of the finely pulverized coal in a small platinum dish (weighing about 8 grammes) with subsequent incineration of this coke in the same vessel. The incineration takes place with great ease and rapidity, and the results are perfectly satisfactory. Thus 3·022 grammes of coal No. 333 gave 2·25 per cent, and 5·263 grammes of the same coal gave 2·58 per cent, deviating from the mean 2·46 by +0·11.

In regard to the ashes of our Iowa coals, I have found that they are very much more uniform in their distribution throughout the coal fields than usually thought possible. In Van Buren county I find the "bottom" coal giving a white or light-coloured ash, the "top" coal of the same bank a red-coloured ash, a fact which I intend to make use of in a subsequent paper on the origin of our coal. I also find the amount of ashes to increase quite evenly (in this county) toward the margin of the coal field from about 2 to 7 per 100 combustible.

DETERMINATION OF SPECIFIC GRAVITY.

Coarse fragments, freed by means of a sieve from all small particles, and averaging 1-10th cubic centimetres in volume, were introduced into a fifty-gramme flask provided with thermometer stopper. The contents for this flask for temperatures varying from 50° to 80° F. had been carefully determined.

The given specific gravity corresponds to the coal perfectly soaked, so that all its pores were filled with water. That required, on the average, 12 hours, permitting two determinations per day, one in the morning, another in the evening.

That this is not at all trifling may be seen from the following example:—2·760 grms. coal (No. 350) gave the specific gravity 1·309 at 64° F., immediately after filling the flask with water; after about 12 hours' soaking, the specific gravity had increased to 1·328, for the same temperature. According to this latter determination, a cubic foot of this coal would weigh 8[illegible] according to the former, only 81·58, or 1[illegible] This shows a considerable degree of por

coal, and indicates the absurdity of giving the weight in pounds of a cubic foot of coal with four decimals, although no statement in regard to temperature or time of weighing is made! Such accuracy we meet with in some of the official reports!

Calculation of Results.

Referring to my previous paper (Chemical News, vol. xviii., p. 53. *Am. Repr., Sept.*, '68, *page* 143), it may be sufficient here to state that, besides the percentage composition of the coal, it is proper to reduce the composition to the combustible=100, in order to obtain a proper comparative estimate of the character of the fuel itself (in regard to the proportion of bitumen and carbon), and of the amount and quality of the impurities (ashes and moisture). It has also been shown in the paper referred to, that, for considerable areas of the coal field, the sum of the constituents on the scale of combustible=100 is the proper caloric equivalent, and that the percentage of the combustible in the fuel gives a proper estimate of its value.

According to this method, a considerable number of analyses of Iowa coals have already been made, and a greater number are yet to be executed. It is believed that the results will be strictly comparable for the entire coal-field of Iowa, and that the conclusions, both practical and theoretical, will deserve some confidence.

RESEARCHES ON GASEOUS SPECTRA

IN RELATION TO THE PHYSICAL CONSTITUTION OF THE SUN, STARS, AND NEBULÆ.*

BY E. FRANKLAND, F.R.S., AND J. N. LOCKYER.

I. The Fraunhofer line in the solar spectrum, named *h* by Angström, which is due to the absorption of hydrogen, is not visible in the tubes we employ with low battery and Leyden-jar power; it may be looked upon, therefore, as an indication of relatively high temperature. As the line in question has been reversed by one of us in the spectrum of the chromosphere, it follows that the chromosphere, when cool enough to absorb, is still of a relatively high temperature.

II. Under certain conditions of temperature and pressure, the spectrum of hydrogen is reduced in our instrument to one line in the green, corresponding to F in the solar spectrum.

III. The spectrum of nitrogen is similarly reducible to one bright line in the green, with traces of other more refrangible faint lines.

IV. From a mixture of the two gases we have obtained a combination of the spectra in question, the relative brilliancy of the two bright green lines varying with the amount of each gas present in the mixture.

V. By removing the experimental tube a little further away from the split of the spectroscope, the combined spectrum was reduced to the two bright lines.

VI. By reducing the temperature, all spectroscopic evidence of the nitrogen vanished; and, by increasing it, many new nitrogen lines made their appearance, the hydrogen line always remaining visible.

The bearing of these latter observations on those made on the nebulæ by Mr. Huggins, Father Secchi, and Lord Rosse is at once obvious. The visibility of a single line of nitrogen has been taken by Mr. Huggins to indicate possibly, first, "a form of matter more elementary than nitrogen," and which our analysis has not yet enabled us to detect; * and then, secondly, "a power of extinction existing in cosmical space."†

Our experiments on the gases themselves show not only that such assumptions are unnecessary, but that spectrum analysis here presents us with a means of largely increasing our knowledge of the physical constitution of these heavenly bodies.

Already we can gather that the temperature of the nebulæ is lower than that of our sun, and that their tenuity is excessive; it is also a question whether the continuous spectrum observed in some cases may not be due to gaseous condensation.

* Abstract of a paper read before the Royal Society, June 10th, 1869.

ON THE ELECTROLYSIS OF NITRATES.

BY THOMAS BLOXAM,

LECTURER ON CHEMISTRY, CHELTENHAM COLLEGE.

The conversion of nitric acid into ammonia by the well-known method of boiling with zinc, iron, and potash, practised by Mr. Harcourt, suggested the idea of such conversion being possible with the hydrogen furnished by means of electrolysis. An experiment of the following nature proved the possibility in a qualitative sense:—Into a small porous earthen cylinder, 1 inch in diameter and 1½ inches high, was placed a little dilute nitric acid, the negative pole of a three-cell arrangement of Bunsen's battery was introduced, and the vessel placed in a small beaker, containing dilute nitric acid and the positive pole of the battery.

The liquid was withdrawn from the cylinder in about half an hour, and the usual test of boiling with excess of potash was tried, when the ammonia was easily detected by the odour and its action upon test-paper.

Nitrate of potassium was substituted for the dilute nitric acid in the porous vessel: ammonia was easily detected in this case also. Nitrate of potassium solution was acidulated with hydrochloric acid, and submitted to voltaic action for an hour. The solution was mixed with bichloride of platinum, and evaporated to dryness, when a fair amount of the double chloride of platinum and ammonium was obtained. This precipitate was examined, and found to be entirely pure.

The question then suggested was, whether any quantitative result could be obtained. For this purpose the porous cylinder used in the previous experiments was cemented to a glass tube, of the same diameter and 6 inches long, in order that any splashings caused by the escaping bubbles of gas should not cause an error. The compound tube was placed in a beaker, high enough to take the porous vessel, and just large enough to admit the positive pole. The tube and beaker were placed in a moderately large vessel of cold water, to keep down the temperature, which, in a previous experiment, had softened the cementing material joining the tube and porous vessel. The arrangement is represented in the figure. A weighed amount of pure nitrate of sodium was placed in the porous vessel, and submitted to electrolysis, the ammonia being estimated as the double chloride of platinum and ammonium.

From a considerable series of experiments, the amount of double chloride yielded was found to be below the

* *Phil. Trans.*, 1864, p. 444. † Ibid., 1868, p. 544.

calculated result. Several modifications were then tried; such as dropping the solution of the nitrate very slowly upon the negative pole, elevation of the temperature both of the solution and of the battery; reduction of the resistance offered to the voltaic battery. It is to be regretted, however, that, in spite of a fairly extensive series of experiments with these various modifications, I have only succeeded in converting half the nitrate into ammonia. It has been also proved that no loss of liquid takes place through the porous vessel.

I have been induced to make known these results with the hope of obtaining some suggestion which may solve the difficulty of the non-conversion of the other half of the nitrate.

ON THE

ACTION OF HYDROCHLORIC ACID ON MORPHIA.*

BY AUGUSTUS MATTHIESSEN, F.R.S.,
LECTURER ON CHEMISTRY IN ST. BARTHOLOMEW'S HOSPITAL,
AND C. R. A. WRIGHT, B.SC.

When morphia is sealed up with a large excess of hydrochloric acid, and heated to 140°—150° for two or three hours, on opening the tubes after cooling no gas is found to have been formed, nor is there any formation of chloride of meth l. The residue in the tube contains the hydrochlorate of a new base, differing considerably in its properties from morphia. It may be obtained in a state of purity by dissolving the contents of the tube in water, adding excess of bicarbonate of sodium, and extracting the precipitate with ether or chloroform, in both of which the new base is readily soluble, whilst morphia is almost insoluble in both menstrua. On shaking up the ethereal or chloroform solution with a very small quantity of strong hydrochloric acid, the sides of the vessel become covered with crystals of the hydrochlorate of the new base. These may be drained from the mother liquors, washed with a little cold water, in which the salt is sparingly soluble, and re-crystallised from hot water and dried on bibulous paper or over sulphuric acid.

This hydrochlorate contains no water of crystallisation. After drying in the water-bath, it yielded results on combustion with chromate of lead and oxygen agreeing with the formula $C_{17}H_{17}NO_2HCl$.

From a solution of the hydrochlorate in water, bicarbonate of sodium precipitates a snow-white non-crystalline mass, which speedily turns green on the surface by exposure to air, and is therefore difficult to obtain dry in a state of purity. This precipitate is the base itself.

It hence appears that the new base is simply formed from morphia by the abstraction of the elements of water.

Morphia. New base.
$$C_{17}H_{19}NO_3 = H_2O + C_{17}H_{17}NO_2.$$

We propose to call the new base apomorphia, for reasons given subsequently.

When the hydrochlorate of apomorphia in a moist state is exposed to the air for some time, or if the dry salt is heated, it turns green, probably from oxidation, as the change of colour is accompanied by an increase of weight. The base itself, newly precipitated, is white, but it speedily turns green on exposure to air. The green mass is partly soluble in water, communicating to it a fine emerald colour—in alcohol yielding also a green tint, in ether giving a magnificent rose-purple, and in chloroform with a fine violet tint.

The physiological effects of apomorphia are very different from those of morphia; a very small dose produces speedy vomiting and considerable depression, but this soon passes off, leaving no after ill effects,—facts of which we have repeatedly had disagreeable proof while working with it.

Dr. Gee is now studying these effects, and has found that 1-10th of a grain of the hydrochlorate subcutaneously injected, or ½ grain taken by the mouth, produces vomiting in from four to ten minutes. Our friend Mr. Prus allowed himself to be injected with 1-10th grain, which produced vomiting in less than ten minutes. From Dr. Gee's experiments on himself and others, he concludes that the hydrochlorate is a non-irritant emetic and powerful anti-stimulant. As from these properties it appears probable that it may come into use in medicine, we have called it apomorphia, rather than morphinine, to avoid any possible mistakes in writing prescriptions.

* Abstract of a paper read before the Royal Society, June 10th, 1869.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.*

BY DR. E. FLEISCHER, OF DRESDEN.

Estimation of Baryta, Strontia, and Lime.

The estimation of these three alkaline earths is generally effected after they are separated from each other. These separations can be dispensed with if the indirect method be employed, thereby avoiding the loss attendant upon different separations, and materially hastening and simplifying the whole estimation. The following indirect method, which has proved to be the most preferable for the estimation of these three bases, may also be employed in the presence of magnesia. In the first place, the lime, strontia, and baryta, must be precipitated as carbonates, by means of carbonate of, and caustic, ammonia. The following is worthy of remark:—It is well known that, in a liquid containing much sal-ammoniac or nitrate of ammonia, neither lime, strontia, nor baryta will be completely precipitated by carbonate of ammonia; so that, after filtering, it is possible, by means of sulphuric acid or oxalate of ammonia, to recognize a more or less considerable quantity. The cause of this phenomenon is, that ammoniacal salts of strong acids have a solvent action upon carbonate of lime, which effect is still stronger upon carbonates of strontia and baryta. Should, on the other hand, acetate or carbonate of ammonia be used, instead of sal-ammoniac or nitrate of ammonia in solution, the precipitation of the three bases by carbonate of ammonia will be so complete that it will be impossible to discover in the filtrate, by means of the before-mentioned reagents, any traces of lime, strontia, or baryta.

In order to have in solution no other ammoniacal salts than acetate and carbonate of ammonia, it will suffice to add to the tolerably neutral solution as much acetate of soda as there is supposed to be sal-ammoniac or nitrate of ammonia held in solution, and then to supersaturate with ammonia and carbonate of ammonia, and, after a short digestion, to cool the solution; the carbonated alkaline earths which have in this manner been completely precipitated are now filtered off.

Digestion is not absolutely necessary here; it only serves to render deposits granular, which would o

* Communicated by the Author.

wise be voluminous. On the other hand, in order to obtain complete precipitation, it will be necessary to reduce the whole to the ordinary temperature before filtering, because hot acetate of ammonia has a solvent action upon carbonated alkaline earths, although in a far less degree than sal-ammoniac.

A certain degree of dilution of the ammoniacal salt is to be recommended; in any case, the solution must not be more concentrated than in the proportion of one salt to twenty water. According to rule, I manage so as to dilute the digested mass with its own volume of distilled water, allowing it to cool still further before filtration.

The carbonate of soda may be substituted for the acetate, in order to decompose the sal-ammoniac; but if, at the same time, magnesia be held in solution, the presence of much salts of ammonia, with stronger acids than carbonates, will be necessary in order that it may not be deposited with the alkaline earths. For this purpose, the addition of acetate of soda is eminently suitable; because the acetate of ammonia thus formed (as with oxygenated salts of ammonia generally) prevents the precipitation of the magnesia much more than sal-ammoniac does, without, as before remarked, dissolving baryta, strontia, or lime.

In the presence of magnesia, a too great excess of carbonate of ammonia must be avoided as a reagent, in order to hinder the formation of ammoniacal carbonate of magnesia, which is difficult to dissolve. After these precautionary measures, the baryta, strontia, and lime having been separated (also from magnesia, if such be present), the deposit is washed, filtered, dried, heated, and weighed; it is then dissolved in a measured quantity of normal muriatic acid and estimated. This is done, after removing the carbonic acid by digestion, from the diluted solution (which is coloured with litmus) by estimating with one-half normal ammonia the amount of muriatic acid which had been required to transform the three carbonated salts into chlorides. The solution is now mixed with bichromate of potash and caustic ammonia in excess, to precipitate all baryta, so that no trace of it may be detected in the acidulated filtrate, by fluo-silicate of potash and spirit of wine.* The chromate of baryta is filtered off, and washed until sugar of lead ceases to give a yellow precipitate in the solution which runs through; to this chromic acid is now added, according to the known process, together with a measured quantity of a standard solution of green vitriol; and the amount of baryta is then obtained, according to the formula—

$$CrO_3 \times 1{,}527 = BaO.$$
$$\text{or } CrO_3 \times 1{,}964 = BaOCO_2.$$

If, on the one hand, the amount of carbonate of baryta thus obtained be deducted from the weight of the three carbonates, and, on the other, the amount of muriatic acid answering to the baryta be calculated, the difference between this amount of HCl and the amount found will be the quantity of muriatic acid which corresponds to the united weight of CaO,CO_2 and SrO,CO_2, which has just been calculated. The amount of carbonate of lime and carbonate of strontia is obtained as follows:—

Calculate the amount of carbonate of lime which is equivalent to the known quantity of HCl contained in the excess of $CaOCO_2$, and $SrOCO_2$; deduct this from the weight of the two carbonated salts, and multiply the remainder by the constant factor $3\frac{1}{17}$, and the product will then be the required quantity of $SrOCO_2$; this, when again subtracted from the united weight of both salts, yields, as its remainder, the quantity of carbonate of lime. The constant factor, $3\frac{1}{17}$, may be obtained by the following calculation:—

$CaOCO_2 =$	50
$SrOCO_2 =$	74
$CaOCO_2 + SrOCO_2 =$	124
hence $2CaOCO_2 =$	100

and the remainder, 24, in the equivalent of $SrOCO_2$, equal to 74, yields, when divided, $S = \frac{74}{24} = 3\frac{1}{17}$.

This method of estimating these three alkaline earths always yielded very satisfactory results. One advantage is that it is quickly carried out and also very exact, because the precipitations will be all perfect, and the two volumetric estimations involved in the method admit of great exactitude. Moreover, the troublesome and somewhat uncertain separation of the strontia and lime with a concentrated solution of sulphate of ammonia is avoided, and which is very inconvenient in estimating the lime. In the absence of strontia, I either precipitate the lime and baryta as carbonates,* estimating the precipitate alkalimetrically; or I precipitate the baryta as sulphate, the lime as carbonate, by digesting the solutions of both with a mixture of three parts of sulphate of potash and one part of carbonate of potash; weigh the dried and ignited precipitate, and estimate the carbonate of lime alkalimetrically.

Normal Liquids for Volumetric Analysis.

In the greater number of analytical examinations of free acids and alkalies, the rule is to employ a normal acid, and a normal solution of caustic potash, and also a tenfold dilution of them (1-10th of the normal liquids). In choosing the most appropriate acid for this purpose, it must be taken into consideration that it should form with alkalies or alkaline earths only soluble salts, in order that certainty in discerning the change of colour in the liquid under examination—which is coloured with litmus—may not be injured by precipitates, and also that the carbonates of the alkaline earths may be perfectly transformed by the normal acid. On this account, nitric acid is much more useful as a normal liquid than sulphuric or oxalic acid; but hydrochloric acid is quite as appropriate as a standard solution as nitric acid, and more so, inasmuch as it is more easily obtained pure, and is more constant to one standard, while nitric acid is generally more or less contaminated by nitrous acid. Another advantage possessed by hydrochloric acid is, that the acid contained in it may be not only estimated alkalimetrically, but also quickly and exactly by a standard silver solution, a trial which is impossible in the case of nitric acid.

With regard to volatility, it is to be mentioned that hydrochloric acid, diluted to one-fifth of the normal strength, when heated for ten minutes, whilst replacing the evaporating water, will not impart the slightest tinge of red to a blue litmus paper held in the vapours evolved, and, as in alkalimetric investigations the dilution is much greater, there need not be any fear of ever driving off the free acids by digestion. Moreover, since the constancy of normal hydrochloric acid is so great that, after keeping for months, the slightest change can scarcely be perceived, provided it has been preserved in bottles

* Pure chloride of barium solution, also, produces no turbidity when, after the precipitation of baryta by chromate of potash and ammonia, the filtrate is mixed with sulphuric acid. It is, of course, understood that the reagents employed in precipitation are quite free from sulphuric acid.

* Especially when magnesia is present.

well closed with glass stoppers, no impediment exists in this respect to its employment as a standard liquid.

It is well known that many chemists besides myself have performed these experiments successfully with normal hydrochloric acid, and that, in all alkalimetrical determinations, they already use it instead of normal sulphuric or oxalic acid; it is hoped, therefore, that these remarks will suffice to demonstrate the utility of this testing liquid.

The second important normal solution for analysis by saturation is normal caustic potash or soda. These caustic liquids should be completely and absolutely free from carbonic acid, and, in order to prevent them from absorbing this gas from the air, a mixture of Glauber's salt and caustic lime is employed. This is contained in a tube fastened into the stopper of the bottle which contains the alkali; but this precaution does not always suffice to retain the solution of caustic alkali perfectly free from carbonic acid, for it almost always happens that an addition of a solution of chloride of barium to it produces a precipitation of carbonate of baryta in greater or smaller proportion. The preservation of caustic alkali by this means is also inconvenient, as, on account of the syphon in the bottle, it requires to be placed over the working bench, and can, therefore, only be protected from the dust by a special cover. To these drawbacks may, perhaps, be ascribed, in technical laboratories, the frequent substitution of the more easily preserved, though less appropriate, solutions of carbonate of potash or soda for the caustic alkaline solution as a normal standard liquid.

All these inconveniences, which exert more or less influence upon the exactitude of estimation, may, however, be remedied by employing, instead of the normal potash or soda solution, caustic ammonia of half the normal strength. Of all caustic solutions, caustic ammonia displays the most complete indifference to carbonic acid; so complete, in fact, that a flask half filled with half normal ammonia, well closed with a glass stopper, and which was frequently opened for estimations to be made, gave such slight indications of carbonic acid after three months' preservation, that, upon half filling a large test-glass with it, and adding some drops of concentrated acetate of lime, no perceptible turbidity ensued, even on heating; whereas two bubbles of carbonic acid gas introduced into it from a gasometer instantly produced a considerable deposit. Moreover, the standard of this half-normal liquid was so slightly altered during the three months, that 1-10th c.c. of a tested normal muriatic acid was scarcely less saturated by 50 c.c. of it, than would have been necessary by an exact standard.

It follows from these experiments that the half-normal ammonia liquid is at least as useful in acidimetrical work as the best caustic potash solution; besides which the former has the advantage of being conveniently preserved, and of being easily obtainable chemically pure.

With respect to the importance of the appearance of a blue colouration of the litmus by a liquid reddened by free acid, so as to fix the final reaction in analysis by saturation, the following is worthy of remark:—

Cold diluted (to at least 1 : 10) solutions of neutral sulphate or nitrate of ammonia scarcely produce any perceptible change in blue litmus paper—at any rate, much less than that produced by the introduction of two bubbles of carbonic acid. Sal-ammoniac reacts, under these circumstances, as neutrally as chemically-pure chloride of potassium, or chloride of soda; and a single drop of half-normal ammonia produces in such litmus-coloured solutions a strong and lasting blue colour, slightly inclining towards violet.

Hot solutions of the ammoniacal salts in question, and especially sulphate of ammonia, act upon litmus in a somewhat acid manner, about the same as free carbonic acid; hence it follows that, in all estimations by ammonia, the liquid to be tested should be cold. Should it have been previously heated, it is advisable that it should be cooled as much as possible by first exposing it for some minutes to the air, and then setting it in cold water. If this be attended to, the distinctness of the tint will leave nothing to be desired. The objection may be raised, that ammonia cannot be employed, like potash or soda, as a normal, but only as a half-normal, liquid; the relation of the base to the acid as 2 : 1 is, however, more advantageous to the exactness of the determination than if both fluids possessed the same equivalents.

As all volumetric estimations, excepting those of such caustic liquids as caustic soda, potash, baryta, and ammonia, are finished by re-estimating the acid with ammonia, and, as 1 c.c. of normal muriatic acid corresponds with 2 c.c. of half-normal ammonia, the re-estimation is much more exact than if solutions were used containing equal equivalents. The usual 1-10th normal solutions may also hereby be dispensed with in almost all cases, if the experiments be carefully carried out. These remarks will demonstrate that I can specially recommend the employment of half-normal ammonia and of normal muriatic acid as standard liquids for analysis by saturation; at the same time, I may observe that, for testing acids combined with metallic salts, I employ normal potash, supersaturating with a measured quantity of muriatic acid the free potash present in an aliquot part of the filtrate, calculating the combined acid after removing the carbonic acid by heat, and re-estimating with ammonia.

The standard of the normal muriatic acid is ascertained by a weighed amount of pure carbonate of lime, slightly heated. The best way to preserve both liquids is in well-closed flasks, with glass stoppers. They should be placed in a cool place, free from dust. In hot summer weather, the flask containing the half-normal ammonia should be placed in cold water, which should be renewed daily, because a continued temperature of 25° C. will alter its standard, though only in a slight degree.

THE FARADAY MEMORIAL.

The Faraday Lectureship has been worthily inaugurated. M. Dumas, representing not alone the chemists of France but the chemists of Europe, has given us a lucid and comprehensive discourse, in which he has surveyed, from our present stand-point, the position of chemistry and its relations with past science, and has, moreover, pronounced an admirable *éloge* of him whom the discourse commemorates. No one could be more eminently fitted than M. Dumas to undertake this duty: he was the intimate friend of Faraday, and with him he somewhat connects the chemistry of the past with the chemistry of our day; he stands pre-eminent among the chemists of his country, and has had much influence upon the entire *cultus* of France during the last quarter of a century. And what are his relations with the past? He was born a few years after the death of Lavoisier; at the time when he entered the chemical world the system of Lavoisier was firmly established, was universally accepted. He may have seen as a boy the death

of Phlogiston—that slow, long-drawn-out death, not with gasping and a discoloured visage, not with a strong clinging to life and mortal strugglings; it was rather the death of the aged and worn-out, almost a euthanasia. Phlogiston died as an old king, once infinitely dominant, somewhat tyrannical, not always just; now deposed, decrepit, utterly senile, forsaken by all, and ever harping upon his former glories. It was Lavoisier who founded the new dynasty, of which ours is as much a continuation as was the dynasty of Elizabeth of that of Henry VII. The times have changed, the *modus* of thought has changed, characteristic developments have assumed new features, and appeared with altered and contingent phases, but the basis is the same—it is firm and immutable as to its facts; and all philosophy, of what kind soever it be, all science, all social actions, are alone stable when they are founded upon the immutability of fact. We were glad to notice that M. Dumas made much mention of Lavoisier in his discourse; but not glad to observe that, while the names of Davy and Dalton were received with applause, that of Lavoisier was passed in silence. This is ungenerous and illiberal. We need not go quite so far as M. Wurtz, in his recent "History of Chemical Theory," but let us at least acknowledge to the full that which Lavoisier has done for chemistry. In neglecting him, we not only act unjustly, but we injure ourselves; for, did not Lavoisier confess himself the pupil of Black? And, as to the arrogance attributed to him in regard to the name of his chemistry, it seems to be forgotten that Fourcroy introduced the term *La Chimie Française;* it was a just term, and, till lately, no one has complained of it. Does not Davy speak of the "new French chemistry?" Let us forget these petty jealousies. The very institution of the Faraday lectures will, by establishing cordial unions between scientific men of foreign countries and those of our own, help to dissipate these feelings, and to produce a more complete *entente cordiale.* Meanwhile, let us express for Lavoisier, in the words of M. Dumas (in his admirable "Leçons sur la Philosophie Chimique"), "notre profonde admiration pour son génie, et notre douleur éternelle pour sa mort prématurée." And let us express, for M. Dumas himself, the first of these sentiments, and thank him for having come among us: this man, who was a great chemist before many of us were born; who, more than forty years ago, wrote a many-volumed work on chemistry, which has been the text-book of a generation or so of young chemists; and who has ever furthered and adorned our science.

A word or two, about the medal which accompanies the Faraday lectureship. Of the design, and the legend which accompanies it, we fear we cannot speak in great praise, and therefore shall not speak at all; but some may be interested in knowing that the medal is to be struck in palladium, and that a quantity of this rare metal, sufficient for the medals of at least ten years to come, has just been presented to the Chemical Society by an eminent metallurgical firm. And, *àpropos* of this, we may mention that M. Dumas carries back to France with him, in addition to the Faraday medal, a medal of the alloy of palladium and hydrogenium to commemorate the discovery of the latter by the Master of the Mint.

It is a matter of much satisfaction to know that at length steps have been taken to provide a memorial to Faraday in another form. While the lectureship and medal are the special memorial of the Chemical Society, this is to be the memorial of the country at large, and it is proposed that it should take the form of a statue. That the Government have held aloof from taking any part in this memorial is much to be regretted, but the Chancellor of the Exchequer has stated that he is only following precedent in not allowing public moneys to be expended on a memorial to a "private citizen." But was Faraday a *private citizen?* In one very limited sense, indeed, he was, but, in point of fact, he was a cosmopolitan. "Faraday," said M. Dumas, "n'appartient pas seul à l'Angleterre, il appartient à tout le monde." A private citizen! Who has worked more for the public good? Who has more promoted works for the weal of his country, for the welfare of his race? We hope that not only the scientific men of this country will promote the Faraday memorial, but that the whole country will subscribe to it, and that we may have not alone a statue to this great man, not alone the lectureship and medal, but some greater work, and we would suggest, as we have before done, that it should take the form of a Public Laboratory, which would afford to those who have longings for science, but who lack opportunity, a means of satisfying the yearnings of their genius. To those who "fall gloriously fighting" in the service of their country,—to those who in the Senate have promoted large interests, successful negotiations, an honourable peace, or a triumphant war,—the country and the Government never fail to raise memorials, and to give honour: let them honour him who, working quietly, and steadily, and firmly, has added so much to the internal wealth of this country, so much to the scientific literature of the world. Faraday ever held in his hand "Lampas investigationis, non torris contradictionis," and the bright steadfast light illumines all that he did, and enveloped him as he passed untimely from our sight.

ON THE

ACTION OF HYDROCHLORIC ACID ON CODEIA.*

BY AUGUSTUS MATTHIESSEN, F.R.S.,
LECTURER ON CHEMISTRY IN ST. BARTHOLOMEW'S HOSPITAL,

AND C. R. A. WRIGHT, B.SC.

Codeia was sealed up with from twelve to twenty times its weight of strong hydrochloric acid, and heated to about 140° for two or three hours. After cooling, a layer of colourless liquid was observed floating on the top of the brown tarry contents. It immediately became gaseous on opening the tubes, and was presumedly chloride of methyl, as the issuing gases were found to be free from carbonic acid. The residue in the tubes, when dissolved in water and precipitated by carbonate of sodium, yielded, on extraction with ether and agitation with hydrochloric acid, a crystalline chloride, having, when purified by recrystallisation, all the properties of the chloride of apomorphia derived from morphia. It gave the same qualitative reactions, produced the same remarkable physiological effects, and yielded numbers on combustion with chromate of lead and oxygen agreeing with the formula $C_{17}H_{17}NO_2HCl$. Hence the reaction which takes place is in accordance with the formula—

Codeia. Apomorphia.

$$C_{17}H_{17}CH_3HNO_3+HCl=CH_3Cl+H_2O+C_{17}H_{17}NO_3.$$

* Abstract of a paper read before the Royal Society, June 10th, 1869.

ON THE

ATOMIC WEIGHTS OF GOLD, PLATINUM, IRIDIUM, OSMIUM, RHODIUM, AND PALLADIUM.

BY W. M. WATTS, D.SC., F.C.S.

THE atomic weight of gold was determined by Berzelius from the analysis of its double chloride with potassium. He obtained, as mean result, the number 196·67, which was calculated from the weight of potassium chloride left, assuming its atomic weight=74·57. My pupil, Mr. R. A. Jones, has pointed out that, since Berzelius determined in each case not only the potassium chloride left, but also the metallic gold set free, we have data for calculating both the atomic weight of gold and also that of potassium; so that, by comparing the atomic weight of potassium calculated from Berzelius's numbers with that given by the marvellously accurate researches of Stas, we are able to estimate the degreeof accuracy of Berzelius's results. Berzelius obtained (*Lehrbuch der Chemie*, iii., 1212), in four experiments, the following results:—

	$AuKCl_4$. Grs.		KCl. Grs.		Au. Grs.
(1).	4·14450	gave	0·81850	and	2·15900
(2).	2·24950	"	0·44425	"	1·17200
(3).	3·41300	"	0·67400	"	1·77725
(4).	4·19975	"	0·82950	"	2·18800

Calculating from Stas's number for chlorine, viz., 35·457, we obtain the following atomic weights for potassium and gold:—

No. of Experiment.	Atomic weight of Potassium.	Atomic Weight of Gold.
1	39·149	196·79
2	39·166	196·87
3	39·088	196·57
4	39·176	196·86

If we select experiments 3 and 4 as the best, and take the mean, we have K=39·132, and Au=196·71.

The extremely close agreement of the numbers for potassium with that given by Stas, viz., 39·133, can be considered as little less than marvellous, and may, I think, be regarded as investing the atomic weight of gold with authority scarcely less than could be obtained by a repetition of the determinations, with all the minute precautions which Stas employed in his experiments.

It must not be forgotten, however, that in this way we check only the accuracy of manipulation, but obtain no evidence of any error arising from impurity of the metal employed.

I have applied the same criticism to the results obtained in precisely the same way for platinum, iridium, osmium, rhodium, and palladium, none of which, however, exhibit the accuracy of the gold determinations; and the best result is probably obtained by calculating from the atomic weight of potassium chloride instead of from chlorine alone.

The results are subjoined—

	Calculated from Cl=35·457.		Calculated from KCl=74·59.	Authority.
Platinum	K=39·35	Pt.=197·75	Pt.=197·18	Berzelius
Iridium	K=39·39	Ir.=197·54	Ir.=196·87	"
"	K=39·87	Ir.=198·56	—	Claus
"	K=39·93	Ir.=196·62	—	"
Osmium	K=39·28	Os.=199·42	Os.=199·03	Berzelius
Rhodium	K=39·12	Rh.=104·21	—	"
"	K=39·89	Rh.=104·76	—	"
Palladium	K=39·62	Pd.=107·19	Pd.=106·57	"

Manchester Free Grammar School,
June 18th, 1869.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

June 3rd, 1869.

DR. W. A. MILLER, V.P.R.S., &c., *in the Chair*.

THE minutes of the preceding meeting having been read and confirmed, the following certificates were read:—

For the first time—John Morrison, Analytical Chemist, County Wicklow, Ireland; W. G. Lewis, Fellow of Oriel College, Oxford; Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland.

For the second time—Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. Fletcher Barrett, Lecturer on Physical Science at the London International College.

For the third time—William G. Valentin, Assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gilham Hewlett, Surgeon, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A., Oxford, Sympsham Rectory, Weston-super-Mare. The last named gentlemen were balloted for and duly elected.

Mr. Gerstl was proposed as an associate of the Society.

The PRESIDENT (Dr. Williamson) then read a lecture on "*The Atomic Theory*," but, as it is difficult for us to give a condensed report which will do justice to so important a subject, and as the author has, with his usual courtesy, kindly promised to send us an abstract, we postpone our report of this paper for a future number.

The CHAIRMAN proposed a vote of thanks to Dr. Williamson, and said that it would be better to defer the discussion until the next meeting. He would, however, remark that those who opposed the atomic theory must explain how, according to the notion of the infinite divisibility of matter, they had combination in definite proportion at all. It seemed to him utterly impossible to explain combination in definite proportion by the theory of infinite divisibility.

The PRESIDENT announced that, as the next meeting would be taken up by M. Dumas's lecture at the Royal Institution, another meeting would be held for the ordinary business of the Society; the date was not, however, announced.

The meeting then adjourned till the 17th inst., at the Royal Institution.

Meeting held at the Royal Institution, June 17th, 1869.

DR. A. W. WILLIAMSON, F.R.S., *President, in the Chair*.

THE minutes of the previous meeting were read and confirmed, and the following certificates read:—

For the first time—E. A. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

For the second time—John Morrison, Analytical Chemist, County Wicklow, Ireland; W. G. Lewis, Fellow of Oriel College, Oxford; Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland.

The PRESIDENT then addressed the meeting as follows:—

The Society is here assembled to inaugurate what would be inadequately described as a monument in honour of Faraday. The Faraday Lectureship has been founded by the Council of the Chemical Society in the hope that it will promote the advancement of human knowledge, and surely no higher tribute of respect could be paid to a great man than to do in his name what he would have loved best to see done. Now, among the arrangements which are made for the promotion of interchange of ideas—ideas which are so essential to those who are working in the investigation of nature—there is one particularly important defect and shortcoming. We have books and papers which circulate throughout the length and breadth of the civilised world, and in each country there are Societies where men meet together to consider and discuss questions relating to science, and to aid and encourage one another in various ways. But these

books and papers give but the skeleton of a science without that life and interest which is imparted to facts when communicated by a discoverer himself. And, on the other hand, Societies, although they do much for the promotion of science, leave still more undone. It is an essential of truly philosophical work that questions be viewed from various sides; and those who have followed with any attention the recent history of our young science, must have been struck with the variety of lines of thought followed simultaneously by independent workers—lines of thought which finally converge in certain general truths; their convergence serving to corroborate the evidence of those truths, and to establish more perfectly the conclusions which are thus arrived at. Now, the greatest difficulty which is experienced, and the greatest defect which one observes, is this, that workers in one line of thought are too frequently ignorant, or insufficiently cognizant of what others are doing; and the defect shows itself chiefly between those who are working in different countries, more than between those who are working in the same country. Now, imagine that we could induce to come among us a man possessed of one of those master minds which forms a focus of light throughout science, and amongst all those who are interested in science: suppose that he were to tell us the thoughts which are uppermost in his own mind, and—best of all—that he were to make us for a time think with him in the very words of his own language: imagine that such a highly gifted man combined in his own person the genius of a discoverer, the breadth of intellect of a philosopher, and the lucid fluency of an orator. I am sure that you would agree with me, that his visit would inaugurate something which Faraday would truly have rejoiced to see. Imagine, I say, those things: accurately fix in your mind's eye the image of such a man—and Dumas is before you! [Loud applause.]

M. Dumas, La Société vous reçoit comme le plus illustre representant du progrès de notre science. Nous sommes heureux et fier de vous avoir parmi nous,—heureux de vous voir et de vous entendre, fier de ce que vous êtes venu au nom de Faraday. Je vous presente cette medaille qui a été frappée en commemoration de votre visite, et je vous prie de conserver avec elle le souvenir de cette réunion.

M. Dumas's lecture* commenced with a brief *éloge* of his friend, the late Professor Faraday. The Lecturer then, with admirable eloquence, passed to the consideration, first, of what he termed "*la matière brute*," and of its forces; and, secondly, of organic matter and the forces special to it. He traced the origin of some of the more important modern chemical doctrines to the labours of the Greek philosophers, and identified the principle of the ancient classification into fire, air, earth, and water, with that of Lavoisier's chemical elements. He acknowledged his great admiration of the labours of Dalton and Prout, and in a most lucid manner pointed out relations between the atomic weights of the now received elements which led him to infer the probability of many of them having a common basis. The audience was reminded that many years ago M. Dumas had contended that organic bodies are constituted in a manner similar to mineral bodies, and he took occasion to show how the progress of chemical research had confirmed the truth of this view, he himself being disposed to limit the term "organic substance" to those very few compounds which take part in the growth of organized beings.

Professor Tyndall then spoke as follows:—Fellows of the Chemical Society, Ladies, and Gentlemen—It becomes my duty to ask you to return your best thanks to M. Dumas for the noble discourse which you have just heard; and I sincerely thank the President of our Society for giving me this opportunity of testifying to the respect and high regard which I personally entertain for our first Faraday lecturer, both as a man and as a philosopher. [Applause.] It is now, Sir, [turning to M. Dumas] one and twenty years since, in company with the gentleman who now sits at my side, I first heard your voice. It was in your own *College de France*, and to this hour I have not forgotten the impression that you then made upon me with regard to your clearness, your power, and your eloquence as an expositor of scientific truth. You then, Sir, were celebrated as an investigator, and, as I thought, you were in the very blossom of your strength; but, Sir, I was wrong. You have this night shown a vigour and a depth and a capability of grappling with great questions, such as I doubt whether you possessed in equal vigour twenty-one years ago. You have to-night, Sir, grappled with some of the weightiest questions which underlie both chemistry and physics, and which constitute, if I might be allowed the term, the very solder of the material universe; and you have, moreover, vindicated the claims of science to a higher recognition than that which may be fairly based upon the material results that flow from it. You have shown how it can connect itself with philosophy, and with the general culture of the human mind. Sir, the walls which here surround you are associated with immortal memories. For more than sixty years they have been accustomed to hear voices which have gone forth into all lands. They have heard the voice of the great Thomas Young, of Humphry Davy, and of Michael Faraday; and we, Sir, bid you welcome to the scene of their teachings and of their triumphs. [Loud applause.] We, Sir, wish with all heartiness that you may long preserve the vigour which you have here displayed to-night, employing it as you have just done, for the delight of your hearers, the honour of science, and the good of mankind. [Applause.]

Professor Odling: I feel it a great privilege, and at the same time a great difficulty, after the eloquent remarks of Dr. Tyndall, to second the vote of thanks to M. Dumas, which he has proposed. As an old officer of the Chemical Society I may say we all felt that we could not find a more fitting or more able inaugurator of the Faraday lectureship than M. Dumas; but we also found that we could not find anyone more willing—I might say more desirous—to make the sacrifice of time and convenience that was demanded of him in order to do honour to the memory of that great man whose name we are this night met to commemorate. I think, however, that our vote of thanks to M. Dumas for his eloquent address, and for his coming over among us to deliver it, must not be lessened by the consideration that it was impossible for him to surprise us, or at any rate those of us who know him, by any display of eloquence and any display of kindness, however extreme. I call upon you then, with every mark of enthusiasm, once more to show M. Dumas how much you appreciate his kindness in coming among us, and how much you feel the honour of his presence, and the benefit to be derived from his most eloquent address. [Loud and prolonged applause.]

The President: It is unnecessary to put the motion, for it has been carried by acclamation.

M. Dumas replied in a short but eloquent speech, and the President announced that another meeting of the Society would take place at Burlington House, on the 1st of July, when papers will be read by Mr. R. H. Smith and Dr. Phipson.

* We have purposely given only a short notice of Professor Dumas's oration, as a verbatim report will appear in our next number.

CHEMICAL SOCIETY DINNER

On the Occasion of the Inaugural Faraday Lecture by M. Dumas, June 18th, 1869.

In another part of this number we have given an account of the magnificent lecture by M. Dumas. We have here the pleasing duty of giving a brief account of the banquet given to the eminent philosopher and chemist on the evening after the delivery of his inaugural Faraday discourse. As may be supposed, there was a large attendance of Fellows of the Society, all of whom were anxious to do honour to the memory of Faraday, and also to show their esteem and admiration for one who was a personal friend of Faraday, and who occupies one of the highest places amongst our continental scientists. The chair was occupied by the

President of the Chemical Society, Dr. A. W. Williamson, F.R.S. The following is the list of stewards:—F. A. Abel, F.R.S.; T. Andrews, M.D., F.R.S.; E. Atkinson; J. Attfield, Ph.D.; J. Lowthian Bell; J. H. Brazier; Sir Benjamin C. Brodie, Bart., F.R.S.; A. Bernays, Ph.D; D. Campbell; F. C. Calvert, Ph.D., F.R.S; E. T. Chapman; A. N. Church, M.A.; F. Claudet; W. Crookes, F.R.S.; H. Debus, Ph.D., F.R.S.; Warren De la Rue, Ph.D., F.R.S.; F. Field, F.R.S.; G. Cary Foster, F.R.S.; R. Galloway; J. P. Gassiot, F.R.S.; J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; T. Graham, D.C.L., F.R.S.; G. Griffith; F. Guthrie, Ph.D; A. V. Harcourt, F.R.S.; D. Hanbury, F.R.S.; C. Heisch; F. C. Hills; T. H. Hills; Dr. Holzmann; Sir Robert Kane, M.D., F.R.S.; J. B. Lawes, Ph.D., F.R.S.; G. D. Longstaff, M.D.; A. Matthiessen, Ph.D., F.R.S.; J. Mason; H. Medlock; W. A. Miller, M.D., LL.D., V.P.R.S.; T. Morson, jun.; H. Müller, Ph.D., F.R.S.; S. Muspratt, Ph.D.; E. C. Nicholson; H. M. Noad, Ph.D., F.R.S.; W. Odling, F.R.S.; J. D. Perrins; W. H. Perkin, F.R.S.; Lyon Playfair, C.B., M.P., Ph.D., F.R.S.; D. Price, Ph.D.; E. Ronalds; E. Schunck, Ph.D., F.R.S.; E. Schweitzer; P. Spence; R. Angus Smith, Ph.D., F.R.S.; J. D. Smith; J. Stenhouse, LL.D., F.R.S.; A. Smee, F.R.S.; A. Smee, jun.; J. C. Stevenson; C. Tomlinson, F.R.S.; J. L. Thudichum, Ph.D.; R. V. Tuson; J. Tyndall, LL.D., F.R.S.; J. A. Voelcker, Ph.D.; P. J. Worsley; G. F. Wilson; J. Williams; Col. P. Yorke, F.R.S. After the usual loyal toasts, the Chairman eloquently proposed the toast of the evening, "The Health of Professor Dumas," and spoke of his high scientific skill and attainments in terms which were enthusiastically received by the company; and the health of the guest was drunk with the usual honours, and amidst tremendous applause. M. Dumas replied in a fluent and brilliant speech, in which he alluded with great pathos and feeling to Faraday, and also spoke of the pleasure it gave him to accede to the invitation of the President and Council to deliver the inaugural Faraday Lecture. Several other toasts followed, which were appropriately acknowledged, and the speeches were interspersed with a selection of music performed by the band of the Coldstream Guards. The arrangements were exceedingly good, and the way in which they were carried out reflects great credit on the executive committee. The evening was a most agreeable one to all present, and we hope that M. Dumas will long remember the delight and enthusiasm with which he was welcomed to the scene of Faraday's labours. We are certain that the Society will never lose the remembrance of his grand and stirring oration, which will always be associated with the courtesy and kindness displayed by the Master of the French Mint during his short visit amongst us. It only remains for us to hope that for many years we may gain as much pleasure and profit from the Faraday Lectures as we have from this—the inauguration of our memorial to England's great philosopher.

PROPOSED MEMORIAL TO FARADAY.

On Monday last, a public meeting was held in the theatre of the Royal Institution, Albemarle Street, for the purpose of considering what measures shall be taken for the promotion of a memorial to Professor Faraday, whose voice was so often heard as a lecturer within those very walls. The chair was taken at half-past three by his Royal Highness the Prince of Wales, who was supported by M. Dumas, Count Strelecki, General Sabine (the President of the Royal Society), Sir Henry Holland (President of the Royal Institution), Sir Roderick Murchison (President of the Royal Geographical Society), Sir Charles Wheatstone, Professor Williamson, Admiral Manners, Colonel Yorke, Professor Frankland, Mr. De la Rue, Mr. Frederick Pollock, Dr. Gladstone, Mr. Cæsar Hawkins, Dr. Holtzmann, Dr. H. Bence Jones (Secretary to the Committee), Dr. Lyon Playfair, M.P., Professor Tyndall, Professor Graham (the Master of the Mint), Sir John Lubbock, Sir Benjamin Brodie, Mr. Gassiot, Professor Miller, and a number of other distinguished personages, both English and foreign. The Astronomer Royal, Sir John Herschel, the Marquis of Salisbury, Mr. Layard, and other gentlemen who had been expected, sent letters to apologise for their absence.

The proceedings were opened by HIS ROYAL HIGHNESS, who, in a few well-chosen words, expressed the pleasure which it gave him, both on public and on private grounds, to preside over such a meeting as the present, and reminded his hearers that, although he whom they had met together to commemorate had been dead for nearly two years, yet nothing had been done by the public as yet to perpetuate his memory. Early in 1868, the Council of the Royal Society requested the President to take measures for the holding of a meeting to promote a monument to Faraday, and, with that view, the Secretary was instructed to write to the presidents of the following societies:—The Royal Society, the Geographical, the Linnæan, the Geological, the Royal Astronomical Society, and the British Association. On the 24th of March, a meeting of the presidents was held, and it was thought desirable, before proceeding further, to learn the views of Her Majesty's Government as to the erection of a monument as a recognition of his pre-eminent services to science and mankind. On the 22nd of June, Mr. Disraeli desired his secretary to say that he considered a monument to Faraday a proper object; but he suggested that its consideration should be left till next year. In the present year, the Chancellor of the Exchequer wrote saying that he had no doubts of the signal merits of Faraday, and he thought that a monument ought to be erected; but he could not consent to devote public money to a monument for a private citizen, however illustrious. He did not make this rule; he found it. On the 8th of June, it was resolved to hold a public meeting at the Royal Institution. Under these circumstances, the Council of the Royal Society, and the presidents of the various other learned societies, had resolved to take the matter seriously in hand without further loss of time, and the result was the present meeting, at which it gave him the greatest pleasure to take the chair.

The first resolution—"That it is desirable that measures should be taken to provide a public memorial to the late Professor Faraday"—was proposed in a short speech by General SABINE, who said that the Royal Society, over which he had the honour to preside, felt a pride and a pleasure in reckoning Michael Faraday as one of its members, and bore his testimony to the fact that, out of all its long list of Fellows, none had contributed such a valuable collection of papers to the *Philosophical Transactions*.

This resolution was seconded by M. DUMAS, Senator, Member of the Academy of France, and Permanent Secretary of the French Institute. Mr. Dumas began by reminding his audience that Faraday, whose genius achieved so much in the cause of science, and, therefore, of civilisation generally, was one of the eight Foreign Associates of the Academy of Sciences of the Institute of France. He also said that it was with pleasure he himself had crossed the Channel to do homage to his memory, and that it was with a feeling of profound emotion that he now found himself standing in the place where his late great contemporary had stood so often. M. Dumas declared that in France Faraday commands as many admirers as in England, and that among these admirers the Emperor of the French stands foremost—so much so, indeed, that his Imperial Majesty never loses an opportunity of evincing his regard for the name of the great *savant*, after whom Paris had named a street, and whose discoveries have not only done honour to England, but have been of incalculable service to the interests of the world at large. M. Dumas then proceeded with great eloquence and perspicuity to touch in detail upon some of the scientific achievements of Faraday, and took occasion to observe that his genius, in its various applications of science to practical purposes, was distinguished by originality, not less than by profundity, instancing his condensation of gas into liquids, his manufacture of steel and of glass, his magneto-electric currents which encircle the world in the telegraph wires, and

his magneto-electric light, to be seen in the most important lighthouses of England and of France. M. Dumas wound up his speech by expressing, in a tone of deep emotion, his own personal regard for a man who was singularly distinguished by his virtues in private life. There were many present who sympathised with M. Dumas when he added that the world at large had cause to lament the loss of Faraday as one of the greatest philosophers who ever shed light upon it by the force of genius, but that he himself had still greater cause to lament in his death the loss of a friend.

Sir Henry Holland moved the second resolution,—"That the following gentlemen be a committee to take the necessary measures for the provision of the said public memorial in honor of Faraday: General Sabine, President of the Royal Society; Sir Henry Holland, President of the Royal Institution; Sir Roderick Murchison, President of the Geographical Society; Dr. Williamson, President of the Chemical Society; Mr. George Bentham, President of the Linnean Society; Mr. T. H. Huxley, President of the Geological Society; Admiral Manners, President of the Astronomical Society; Dr. W. J. Hooker, President of the British Association; the Right Hon. A. H. Layard, M.P., Mr J. Ferguson, Mr. Gassiot, Dr. Tyndall, Mr. Grove, Dr. Frankland, Mr. De la Rue, and Dr. Bence Jones, with power to add to their number."

The resolution was seconded by Sir Roderick Murchison, who referred to the fact that in that very theatre, more than 60 years ago, he had seen Sir Humphry Davy make some of those experiments in electricity which now formed the basis of modern science; and that, standing on the very spot where the Prince now sat, Faraday year after year had carried on those experiments after his master's death, training two successive generations of disciples in the study of the laws of nature. He bore willing and grateful testimony to the extreme modesty and humility of the great man who for more than half a century had made that institution his home, and adverted to the fact that Faraday had first shown marks of his high genius within the walls of the Institution in the year 1823, when Mr. Brande being taken ill and unable to lecture, the duty of lecturing suddenly devolved on his assistant, whose simplicity, sincerity, and genuineness of character even then had begun to make themselves felt, and were but an augury of his after life.

Professor Owen moved the third resolution, to the effect "That a subscription, not exceeding five guineas in amount from any one person, be made for the provision of a public memorial to Faraday." He prefaced this resolution by a few remarks, to the effect that the theatre in which they were assembled was redolent of Faraday and seemed haunted by his spirit. Great and deep as was the learning which he displayed as a lecturer, still his profound and subtle generalisations were almost exceeded by that playfulness of wit by which he raised the intelligence of his hearers without lowering himself from the height of his professional dignity. Of his genius they had heard already from M. Dumas; but enough could scarcely be said of his personal merits, his singular modesty, and that unconsciousness of genius which is so often combined with genius of the highest order, as in Wellington. Like him, Faraday sought no honours, and all that he gained came to him unsought; but Englishmen feel that they all have a share in the achievements of both, and the reputation of the great philosopher, like that of the great warrior, is reflected on all his countrymen. Those, therefore, who are devoted to science have a right to call upon not only men of science, but Englishmen in general, to acknowledge and to pay the debt which we owe to Faraday. Let us think what will be the feelings of a future generation who will look back to him as we look back to Newton. His discoveries of the grand secrets of nature have added to our stores of wealth and ministered to our comforts, and hereafter there will arise the feeling that we have not done as much as we ought for one who has done much for us. He then urged that Faraday and the Royal Institution were standing proofs of the results which could arise out of the voluntary system as opposed to State establishments. Faraday served a voluntary body—a "joint-stock company founded for the purpose of diffusing intellectual pleasure," and this body whom he served gave him a home in which he might carry out his experiments in the field of science. Late in life had come a public recognition of his services in the shape of a pension and a house at Hampton Court—the latter a free gift for life from his Sovereign. He observed that, as the introduction of the electric telegraph and gas had added to the conveniences and comforts of life, and had helped to diminish crime, the discoverers of such secrets of nature at the very least deserved some reward at the hands of those to whom they ministered—if not from the nation in its collective capacity, at least from its individual members; and he concluded his speech by remarking that if any member of either House of Parliament should chance to be present there, he ought to take note of the right relations of the nation to men of science.

The resolution was seconded in a few brief but telling sentences by Dr. Lyon Playfair, M.P.

The three resolutions were severally put to the meeting by his Royal Highness, and declared to be carried unanimously.

A vote of thanks to the Prince for his kindness in presiding over the meeting and for his conduct in the chair was proposed by Sir Henry Holland and seconded by Professor Tyndall, who spoke with great feeling of the loss which both himself and the nation had sustained in the death of Faraday, and alluded to the fact that on that occasion the Prince had been among the first to write to condole with his widow. The motion was carried with great applause.

Dr. Bence Jones then read a letter from Sir John Herschell, excusing his absence on the ground of illness; it ran as follows:—

"I grieve to say that I can only be present in spirit at the meeting of next Monday, the state of my health being such as to preclude my leaving home for many months, most anxious though I should naturally be to show every possible reverence and honour to the memory of such a man as Faraday, whom I have always regarded as the 'blameless prophet' of British science—so clear and far-reaching was he in his views, so indefatigable in their pursuit, so single in his objects, so blameless in his life, so genuine, candid, and unaggressive in all his relations with his brother *savans*."

The Prince briefly acknowledged the vote of thanks, and assured the meeting that he should be proud to lend his aid to the cause which they had met to promote, and it was announced that subscriptions to the "Faraday Memorial Fund" might be paid in at the Bank of England, Western Branch, Burlington-gardens; the London and Westminster Bank, St. James's-square; to Mr. William Hughes, at the Royal Institution, Albemarle Street; or to any members of the committee.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of every chemical paper in the world, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers on a level with the latest advances of science.*

Annales des Mines, vol. 14, sixth series, No. 6.

The greater portion of this valuable periodical is filled with information of use only to the officials and officers of the

Corps Impérial des Ingénieurs des Mines. We meet, however, with a large number of results of analyses of waters, among which is one, very recently made, by M. Peligot, of—

The Water of the Grenelle Artesian Well.—The author calls attention to the remarkable fact that this water does not contain any dissolved oxygen, but only nitrogen, the quantity of which amounts to 14 c.c. to the litre of the water at 10° C. The total saline residue to the litre amounts to 0·142 grm.; the percentage composition of this saline matter is:—Carbonate of lime, 40·8; carbonate of magnesia, 11·5; carbonate of potassa, 14·4; carbonate of protoxide of iron, 2·2; sulphate of soda, 11·3; hyposulphite of soda, 6·4; chloride of sodium, 6·4; silica, 7·0. The same author has estimated the quantity, and determined the quality of the gases contained in rain-water fallen and collected in the neighbourhood of Paris; 1 litre of this water gave off 23 c.c. of gas composed, in 100 parts, of 2·4 parts of carbonic acid; the remainder was a mixture of oxygen and nitrogen, in the proportion of 32 parts of the former to 68 of the latter. M. Stoelet has discovered that the water brought up from the coal-pits contains a greasy matter, soluble in ether, and no doubt derived from the coal; from his observations at and about collieries, he draws the conclusion that this greasy or fatty matter makes the water unsuitable, and, at times, even dangerous, for the use of steam boilers, since it may cause explosions.

It being impossible to quote all, or even the larger portion, of the results of mineral water analysis contained in the above-named periodical, we conclude this brief notice with—

Analysis of the Water of Villa Salic, near Voghera, Piedmont.—M. Tissandier.—The dry residue for 1 litre weighs 65 532 grms., composed of—Chloride of sodium, 61·544 grms., chloride of calcium, 1·031; iodide of magnesium, 1·338, sulphate of lime, 0·144; carbonate of lime, 0·811; carbonate of magnesia, 0·165; silica, alumina, oxide of iron, and organic matter, 0·499; total, 65·532 grms. This water is remarkable on account of the large quantity of iodine it contains.

This number of the *Annales* contains, moreover, a valuable collection of the results of recently made analyses of minerals and rocks from divers parts of the globe.

Bulletin Mensuel de la Société Chimique de Paris, May, 1869.

This number opens with the *extraits des procès-verbaux des séances*, from which we abstract the following:—

Urea.—M. Bouchardat communicated that he had studied the conditions which accompany the production of urea by the action of ammonia upon chloroxycarbonic acid; besides urea, cyanic amides, melanuric acid, and other substances are formed. Hydrogen, in the nascent state, attacks nitrate of urea, thereby producing divers gases, consisting of hydrogen compounds, nitrogen, and carbonic acid. This reaction may be applied to the quantitative estimation of urea, by weighing the quantity of carbonic acid given off.

Oxysulphide of Carbon.—M. Ladenburg gave an oral account of his researches on oxysulphide of carbon. This substance, first obtained by M. Than, by means of the decomposition of sulphocyanate of potassium with dilute sulphuric acid, is also the product of the action of sulphuretted hydrogen upon cyanic ether, and of the action of heat upon thiacetic acid; it is also formed when sulphide of carbon acts upon urea.

Hydrates of Hydrocyanic Acid.—M. Gautier made a few observations on the question of the existence of well-defined hydrates of hydrocyanic acid. The experiments of MM. Bussy and Buignet, on the contraction of mixtures of water and hydrocyanic acid, led to a maximum contraction, corresponding to a mixture expressed by the formula $2CNH + 3H_2O$; if, M. Gautier says, there do exist hydrates, their fusing point must be constant. In order to test this, the author made several experiments on this subject, with mixtures made up of variable quantities of hydrocyanic acid and water taken in definite proportions; not one of these mixtures had a constant melting point (*point de fusion constant*). From his experiments, the author draws the conclusion that two definite hydrates may be said to exist expressed by the formulæ CNH,H_2O and $CNH,2H_2O$; these, by combining together, produce the hydrate $2CNH,3H_2O$.

Iodide of Silicium.—M. Friedel made a brief communication relating to the iodide of silicium, Si_2I_6, which is formed by the action of silver upon the tetraiodide. The first-mentioned substance is decomposed, by heat, into tetraiodide and diniodide; water decomposes this iodide, first forming an unstable hydrate, $Si_2(OH)_6$, which is soon split up, giving rise to the formation of water and silici-oxalic acid, $Si_2H_2O_4$.

Vapour Density of Perchloride of Phosphorus.—M. Wurtz stated that he had repeated experiments on the vapour density of perchloride of phosphorus; his experiments have been conducted at a lower temperature than 160° C, and he has followed the process of Wanklyn, by causing the vapour of the perchloride to diffuse in a known bulk of air. The results of his (Wurtz's) experiments is that 7·2 expresses the vapour density of the perchloride of phosphorus.

The present number of the *Bulletin* contains the following original papers:—

Theory of the Carbides of Hydrogen.—M. Berthelot.—Too lengthy for abstraction.

Formation of Bromide of Acetylen.—M. Berthelot.—The author relates, somewhat circumstantially, how atmospheric influences effect the ready combination of those substances (bromine and acetylen) when in contact; bright sunlight appears to be an essential, but not an exclusive, condition. Since the absorption of acetylen by bromine does not always take place readily, Berthelot advises that when mixtures of gases containing acetylen have to be analysed, subchloride of copper should be used, when no gases but acetylen, absorbable by that substance, are present; subchloride of copper may also be applied as a qualitative test to ascertain whether or not acetylen, when present in a mixture of gases, is being absorbed by bromine, added to the mixture for that purpose. Fuming sulphuric acid was found always to act well, and its action is unaffected by light, a foggy day, or other atmospheric influence.

New Synthesis of Phenol.—M. Berthelot.—This paper is too abstruse for proper abstraction.

Oxidation of the Carbides of Hydrogen.—M. Berthelot.—The author finds that several carbides of hydrogen can be oxidised directly, and without loss of carbon, by the agency of chromic acid dissolved in a small quantity of water. Pure ethylen, free from vapour of ether, is slowly transformed, at a temperature of 120°C., into aldehyd. Propylen is far more readily oxidised, even at the ordinary temperature of the air, aceton being the result of the oxidation; amylen is very violently acted upon by chromic acid, so that no definite products are readily obtained; acetylen is converted into formic and carbonic acids.

"Formation of Substances Homologous with Benzin by the Reciprocal Action of more simply composed Carbides taken in Free State," by M. Berthelot; "Pyrogenic Formation of the Acetylen of the Benzol Series," by M. Berthelot; "Toluidine and Pseudotoluidine," by M. Berthelot; "Researches on the Constitution of Toluen and the Alkaloids Derived therefrom," by M. Rosenstiehl; "New Mode of Preparing Allylic Alcohol," by MM. Tollens and Henninger; "Bromide of Allyl and the Essential Oil of Mustard," by M. B. Tollens; "Boiling Points of the Allylic Compounds," by M. B. Tollens; "Electrolysis of Tartaric Acid and Tartrates," by M. Edm. Bourgoin. These memoirs, evidently concisely written abstracts of longer papers, embodying an enormous mass of scientific research, cannot be properly abstracted, so as to do justice to the authors and their labours.

The remaining pages of this periodical are filled with abstracts taken from papers published in English, German, and

French scientific journals, and also scientific books; but the contents of these abstracts are known to our readers, and are frequently taken from works published some years ago.

Journal für Gasbeleuchtung, April, 1869.

As may be inferred from its title, this periodical is more especially devoted to the interests of gas lighting; occasionally, however, it contains papers of interest to scientific readers, and when this is the case, as in the present instance, we shall make a brief abstract of such paper.

Influence of Heat upon the Regeneration of Sulphide of Iron.—It is well known that, according to theory, only oxide of iron and sulphur should result from the exposure to air of the oxide of iron applied for the purposes of purifying coal gas; in practice, however, it has been found that peroxide of iron, protoxide of iron, and sulphuric acid are also formed, but in variable quantities. Dr. A. Wagner has instituted a series of experiments, in order to ascertain the influence of heat and moisture upon the regeneration process. One sample of sulphide of iron, prepared by the moist way, was kept for three weeks at nearly 100° C., damp, and exposed to air; another portion was kept cold and damp, and exposed, for the same time as the foregoing, to air; while a third portion, under otherwise the same circumstances as No. 2, was kept dry. The result of these experiments is, that heat favours the production of sulphuric acid, while water or moisture does not exert any influence; that moisture and cold (ordinary temperature) produces less sulphuric acid than dryness and cold, since, in the former instance, the occasional watering with cold water, to keep the mass moist, favours a lowering of temperature which, when no moisture is present, is raised, in consequence of the chemical action; water is, however, absolutely required, in order to re-produce the peroxide of iron, since sample 3 was found to have been only very imperfectly converted into peroxide, more than half of the oxide being found as protoxide. The quantities, as deduced from the experiments, are the following:—Sample 1 (hot and moist)—Upon 1 part of S, 0·319 part of SO_3; and upon 1 part of Fe_2O_3, 0·1 part of FeO. Sample 2 (cold and moist)—Upon 1 part of S, 0·034 part of SO_3; and upon 1 part of Fe_2O_3, 0·151 part of FeO. Sample 3 (cold and dry)—Upon 1 part of S, 0·085 part of SO_3; and upon 1 part of Fe_2O_3, 0·5 part of FeO.

Moniteur Scientifique, No. 298, 1869.

This number does not contain any original articles; a portion of its pages are devoted to the description of the specification of patents, the subject matter of which is already known to our readers. Among the miscellaneous matter we observe the following:—

Improved Preparation of Neutral Acetate of Copper.—Five kilos. of sulphate of copper are ground to a fine powder; this having been done, the powder is placed in a suitable vessel, and 7·5 kilos. of liquid ammonia added thereto. After the solution is effected, 10 kilos. of acetic acid are added, and the vessel containing the copper solution placed on a water-bath; as soon as crystals are observed on the top of the liquid, the latter is strongly stirred, which promotes the formation of crystals. By this process, about 4 kilos. of neutral acetate of copper are obtained from the above quantity of sulphate, while the mother liquor yields some sub-acetate of copper afterwards.

Silicium contained in Aluminium.—It is well known that the aluminium of commerce is always contaminated with silicium and iron; a sample of aluminium recently analysed by Prof. Rammelsberg gave as much as 10·46 per cent of silicium, and another sample even 13·9 per cent. The quantity of iron varies from 2·94 to 7·5 per cent.

Silvering Cast-Iron.—M. Bœttger recommends the use *of a bath prepared* in the following manner:—15 grms. of nitrate of silver are dissolved in 250 grms. of water, and 30 grms. of cyanide of potassium are added; when the solution is complete, the liquid is poured into 750 grms. of water wherein 15 grms. of common salt have been previously dissolved. The cast-iron intended to be silvered by this solution should, after having been well cleaned, be placed for a few minutes in a bath of nitric acid of 1·2 sp. gr., just previous to being placed in the silvering fluid.

Les Mondes, May 20, 1869.

We only notice the following from this paper:—MM. Wurtz, Bouchardat, Gübler, and Bergeron have been appointed to study the not altogether easy but important question, Whether the addition of alcohol to wine, after its fermentation has entirely ceased, is injurious to the health of the consumer.

The title of the following work, from the eminent *savant's* well-known reputation, will not, we think, be unacceptable to many of our readers:—"L'Unité des Forces Physiques, Essai de Philosophie Naturelle," par le R. P. Secchi, Membre Correspondant de l'Institut de France, Directeur de l'Observatoire de Rome, Officier de la Légion d'Honneur, &c. Edition originale Française, grand 8vo., xx. and 700 pages; 56 woodcuts. Paris, 1869.

May 27, 1869.

This number does not contain any original communications or papers.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 7, April 24, 1869.

This periodical contains the following original papers:—

On the Toluylen Group.—MM Limpricht and Schwanert.—The authors begin this paper with an introduction, wherein they state that the reader of their present paper is referred back to memoirs of theirs published some years ago; next, they give a review of chief combinations of the toluylen group, being a series of some thirty chemical formulæ and names (too many to quote here); and they wind up with theoretical considerations on the relations existing between benzin, benzoin, toluol, benzil, and toluylen.

History of the Aldehyde of Salicyl.—M. L. Henry.—Since salicylic alcohol—

$$C_6H_4{<}^{HO}_{CHO},$$

is an aldehyde, as well as a phenol, the author argues that it must be possible to obtain, from the salicylic alcohol, doubly chloruretted cresol, triply chloruretted toluol, and chloruretted aldehyde of salicyl. The author has succeeded in obtaining these compounds from the salicylic alcohol, and in this paper he describes, at length, the processes applied. Doubly-chloruretted cresol—

$$C_6H{<}^{HO}_{CHCl_2},$$

is a solid substance, crystallising in prisms, fusing at 82° C.; its alcoholic solution yields, with chloride of iron, a dark red colour. Triply-chloruretted toluol—

$$C_6H_4{<}^{Cl}_{CHCl_2},$$

is an oily liquid insoluble in water; specific gravity, 1·4; boils at 227° C. Chloruretted aldehyde of salicyl—

$$C_6H_4{<}^{Cl}_{CHO},$$

is a colorless liquid, boiling at 210°.

"Tension of Vapour, and Heat of Volatilisation of Chloride of Ammonium," by Aug. Horstman, and "Observations on the Aromatic Theory," by A. Ladenburg, are both too abstruse for translation, an observation which

equally applies to M. Buff's paper, "On the Doctrine of Affinity," a most erudite essay on a difficult subject. Next follow two papers, by two different authors, on the same subject:—C. Rammelsberg's essay, "On the Formation of Periodates from Iodides, by means of Superoxides;" and J. Phillipp's paper, "On the formation of Periodates." "Contributions to our Knowledge of Methyl-Aldehyde," by A. W. Hoffmann. All these papers, being concisely-written and purposely-condensed abstracts made for this periodical, cannot be further condensed.

Polymeric Cyanobromide.—A. Eghis.—When freshly-prepared cyanobromide is placed in a sealed tube, and exposed therein for from eight to ten hours, to a temperature of from 130° to 140° C., the at first crystalline cyanobromide is converted into an amorphous, yellowish-coloured mass, this colouration being due to free bromine, while, at the same time, at the moment of the unsealing of the tube, cyanogen gas escapes. The author found that, with the product prepared in the manner just briefly described, he could not obtain the results he desired to have; he therefore placed freshly-prepared cyanobromide into anhydrous ether, and digested these substances for some time; he thus obtained a perfectly white amorphous powder, insoluble in benzol and absolute alcohol, and fusing at 300°. By analysis, this substance was proved to be a cyanobromide of the formula Cy_2Br_2, containing 74·89 per cent of bromine.

Zeitschrift für Chemie, von Beilstein, No. 8, 1869.

There are no original articles contained in this number, which is entirely filled with translations, chiefly from French papers of older date, the contents of which have already been recorded in the Chemical News.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 24, 1869 (No. 21).

Improvement of the Health of Workpeople, by an Improved System of Ventilation and Better Supply of Fresh Air to the Manufactories.—Illustrated by the good effects obtained at the Weaving Factory of Orival, near Lisieux.—General Morin.—Although, in the strictest sense, the subject matter of this paper does not belong to our department, we briefly notice that, in a factory wherein 400 people are daily employed, it becomes a matter of great importance to see to their health, especially in respect of fresh air. The General having been consulted on this subject by the owner of the factory, the former advised that at least 300 cubic metres per head, per hour, should be allowed for fresh air, provision being made to supply it so as to have a proper degree of moisture, as well as a proper degree of heat; into the minute details of the mode of supply, and carrying off the foul air, we do not enter, as this is a matter very much dependent on local conditions of buildings. The good results are proved by the fact (in this instance) that the yearly outlay for medicines had been reduced from 5,000, to less than so many hundreds of francs; while the consumption of bread had largely increased, as compared with the period previous to the making of the above-named improvements.

Distribution of Heat, and Work of the Induction Apparatus.—M. Le Roux.—This is a physico-mathematical essay, too abstruse for condensation.

Means of Ascertaining the Age of any Writing made with Ink containing an Iron Salt.—M. Carre.—The author states that, as long as writing is not very old, it admits of being copied, when moistened with water only, by means of the well-known copying press; further, that when writing has once attained a certain age, an alteration has taken place in the ink, which prevents the ordinary process of copying being successful; but, in that case, moistening with water acidulated with hydrochloric acid effectually aids the copying process. When, however, writing is some eighty years old, this contrivance also fails to aid the copying process; M. Carré found that writing, made in 1787, could not be reproduced by copying press, even when previously moistened with acidulated water.

Experiments on the Quantity of Mud and Slime carried down by Rivers.—M. Hervé-Mangon.—The author finds that the river Var carries from 9·15 to 36·61 grms. to the litre of water, of mud, amounting in one year, on an average, to 18,000,000 kilos., a quantity sufficient to raise a surface of 5,500 hectares (1 hectare=2·471 acres), 20 centimetres in height. The rivers Marne and Seine carry down far smaller quantities of solid materials.

Second Note on Saturation, Surfusion, and Solution.—M. Dubrunfaut.—This is an abstract too concisely written and too long to admit of further condensation.

New Source of the First Terms of Acids belonging to the Fatty Acid Series, and especially on Propionic Acid.—M. Barré.—We hope to return to this paper, and give it in full, at a future time.

Climate of the Isthmus of Suez.—Referring to this subject, M. Le Verrier read an abstract of a letter from Prof. Buijs-Ballot, the Director of the Royal Netherlands Meteorological Institute at Utrecht, wherein that gentleman states that the draining of the Haarlem lake, in Holland, a surface of 19,000 hectares, has had the effect of increasing the average summer temperature of that locality, and adjacent country, by $\frac{1}{2}$°, and of decreasing the average winter temperature, also, by $\frac{1}{2}$° C.

Cosmos, 22nd livraison, May 29, 1869.

The present number of this periodical does not contain anything fit for abstraction for these columns, though, as usual, the periodical is very cosmopolitan and entertaining to general scientific readers.

Annalen der Chemie und Pharmacie, vi., Supplementband, Heft 3, 1868.

As usual this supplement appears rather late in the present year. It contains the following original essays:—

Combinations of Phosphorus.—M. H. Wichelhaus.—The tendency of this essay, for it is that rather than a paper, may be inferred from the title and introduction, wherein the author says, "It is my aim to prove that it is unnecessary to assume anything else for phosphorus than triatomicity." The author, before entering upon his subject, discusses the word and meaning of quantivalence, and next writes an essay, filling some thirty closely-printed octavo pages, too concisely constructed for further abstraction.

"Isomerism of Bicarbonate of Ethylen and Ethyliden," by M. H. Wichelhaus.—"Development of Heat of Chemical Reactions, as dependent on the Change of the Number of the Molecules of Substances," by Dr. A. Naumann.—"Vapour Tension of Formiate of Ethyl and Acetate of Methyl," by M. C. W. Dittmar.—"Relation existing between the Chemical Composition of Arable Soil, and its Property of yielding a Good Harvest," by M. Schultze.—"Ammonium-Amalgam," by M. Laudolt.—"Isomeric Derivatives of Allyl and Propylen," by M. Alphonso Oppenheim.—"New Method of Formation of Resorcin," by MM. Oppenheim and Vogt.

Journal für Praktische Chemie, No. 4, 1869.

This periodical contains the following original papers:—

On Patellaric Acid, a New Lichen Acid, and its Existence in the Parmelia scruposa.—M. H. Weigelt.—The author has written a lengthy essay on this subject. Patellaric acid is a solid, exhibiting crystalline form and snow-white colour; its taste is exceedingly bitter; it is soluble in water, alcohol, and ether; and these solutions

[English Edition, Vol. XIX., No. 496, pages 274, 275.]

redden blue litmus paper. The percentage composition of this acid is:—C, 53·1; H, 5·2; O, 41·66. Space forbids us to quote any more from this paper, which contains the records of a long series of researches, not only on this acid, but on lichens generally, and the *Parmelia scruposa* especially.

Methintrisulphonic Acid.—M. Theilkuhl.—This acid is obtained when methyloxysulphate of lime is treated with a large excess of fuming sulphuric acid. The lime-salt of this new acid has the following percentage composition:—C, 3·62; H, 0·91; S, 29·00; Ca, 18·13; O, 48·34. The rmula is:—

$$(C_2H)\left[\begin{matrix}S_2O_4\\S_2O_4\\S_2O_4\end{matrix}\right]O_6Ca_3+2H.$$

The author has also studied the baryta, potassa, and lead salts of this acid.

Amylendisulphinic Acid.—Dr. Ilse obtained this substance when he made sulphate of chloride of carbon, $C_2Cl_3(S_2O_4)Cl$, and zinc-ethyl act upon each other. The above-named acid has the following formula:—

$$C_2\left\{\begin{matrix}C_4H_5\left[\begin{matrix}S_2O_2\\S_2O_2\end{matrix}\right]O.H.\\C_4H_5\end{matrix}\right.$$

The baryta salt of this acid is a crystaline solid mass, not readily decomposed spontaneously, of the following composition:—

$$C_{10}H_{10}\left[\begin{matrix}S_2O_4\\S_2O_2\end{matrix}\right]O_2.Ba_2+4H$$

It is soluble in water, difficultly soluble in alcohol.

"Researches on the Influence which the Presence or Absence of Water Exerts in regard to the Vitality of the Yeast, or Ferment Cells."—Dr. J. Wiesner.

Ethylenchloride of Iron and Peruvian Balsam.—M. J. Kachler.—Ethylenchloride of iron, $C_2H_4.Fe_2Cl_3$, is formed when a solution of chloride of iron in ether is submitted to a high temperature in sealed glass tubes; it is a solid crystalline substance. As regards Peruvian balsam, the author states that it yields an excellent source of supply of pure benzilic alcohol. From 100 parts, by weight, of the balsam, he obtained 20 parts of benzilic alcohol, 46 parts of crude cinnamic acid, and 32 parts of resin, which, on being oxidised with potassa, yields benzoic and protocatechucic acids.

System of Elements, according to their Atomic Weights and Chemical Functions.—M. D. Mendeleeff.

Moniteur Scientifique, No. 299, June 1, 1869.

This periodical contains the following original papers:—

Molecular State of Bodies.—M. Persoz.—This paper is a continuation of a series already published on this subject in the above-named periodical, but far too lengthy and abstruse for abstraction.

History of Urea.—M. Bouchardat.—This is a very valuable essay, but too lengthy and too much condensed already to be fit for this portion of our paper. We may, perhaps, afterwards return to this subject.

M. Margueritte's Process of Sugar Extraction from Molasses.—The leading portion of this lengthy paper is known to our readers; it was published some time since.

Chemisches Centralblatt, No. 19, May 12, 1869.

This periodical contains an original paper—

On the Sulpho-Acids of the Isomeric Hydrocarbons, C_9H_{12}.—M. O. Jacobsen.—Cumolsulphuric acid, $C_6H_3(C_2H_7)SO_3$. The cumol was obtained from cuminic acid, *by distillation with five parts of quick-lime.* (Boiling point of cumol, 149°—151° C.) It was dissolved in a mixture of equal parts of fuming and ordinary sulphuric acid, next treated with water and carbonate of baryta, and the cumolsulphate of baryta purified by crystallisation. Free cumolsulphuric acid is a solid substance, very soluble in water and alcohol, and is decomposed by heat without previously fusing. The author studied the potassa, ammonia, lime, strontia, baryta, zinc, copper, and other salts of this acid. The baryta salt belongs to the more stable of these substances.—Isocumol-sulphuric acid, $C_6H_3(CH_3)3SO_3$. This acid, in a free state, is likewise a solid substance, deliquescent, and readily soluble in water and alcohol; it fuses, but becomes at the same time decomposed. It forms crystallisable salts with bases.—Mesitylen-sulphuric acid, $C_6H_3(CH_3)3SO_3$, is also a solid substance, crystallising in six-sided prisms, not deliquescent, readily soluble in alcohol and water, fuses at 100° C., and forms salts with bases, most of which may be obtained in regular crystalline form.—Ethyltoluol-sulphuric acid, $C_6H_4(CH_3)(C_2H_5)SO_3$. Only the baryta and potassa salt of this acid were obtained.—The sulpho-acid of phoron-cumol is a solid substance, readily soluble in water and alcohol; the baryta salt is sparingly soluble in water, and less soluble even in alcohol.

On Ethyldimethylcarbinol.—M. A. Popoff.—This substance—

$$C\left\{\begin{matrix}(CH_3)_2\\C_2H_5\\H\end{matrix}\right\}O,$$

is a fluid boiling between 98·5° and 102° C., and does not freeze at —17° C. Its percentage composition is—C, 68·18; H, 13·62. On being oxidised with chromic acid, it yields acetic acid only.

Bayerisches Industrie und Gewerbeblatt, No. 2, 1869.

This periodical contains chiefly original papers and communications relating to machinery and mechanical engineering; the only original chemical paper is—

Colouring Matter of Wafers.—Dr. Furtenbach.—Although wafers are at the present day far less commonly used for sealing letters than was the case before the introduction of the machine-made gummed envelopes, the researches on this subject are not without interest. The manufacture of wafers is largely carried on at Nurenberg and Munich, and other towns of Germany, and the samples submitted to research were made in the two places just named. Small bright-red coloured wafers left, on incineration, an ash, consisting of oxide of lead, sulphate of baryta, and some sulphate of lead; another sample of wafers, of very bright red colour, was found to be free from sulphate of baryta, and the lead, having been quantitatively estimated, was found to amount to 46·9 per cent of red lead. White wafers were coloured wi h sulphate of baryta—no white-lead was found; blue wafers are coloured, partly with ultramarine, and partly with Prussian blue, but contained, in all instances, besides these substances, sulphate of baryta, and, in some cases, some white-lead; pink-coloured wafers contain carmine lake, alumina being found in the ash; brown-coloured wafers are tinged with iron ochre; violet wafers were found to be coloured with some violet lac-dye, containing alumina; black wafers are coloured partly with lamp black, and also with harmalin black, which, on incineration, left oxide of iron; green coloured wafers are coloured with so-called green cinnabar (chromate of lead and Berlin blue, mixed), also with poisonous copper and arsenical compounds; buff-coloured wafers are coloured with a mixture of oxide of lead, sulphate of baryta, and some oxide of iron.

Journal de Pharmacie et de Chimie, No. 5, May, 1869.

This paper contains the following original essays and papers:—

Formation and Decomposition of Disulphide of Carbon.—M. Berthelot.—Too long and too abstruse for abstraction.

Action of Ammonia upon Phosphorus.—M. Commaille.—The contents of this paper have been already given in an abridged form.

Influence of Pressure upon Chemical Phenomena.—M. Cailletet.—Too long for condensation.

Mineral Chalybeate Water from the Departement de Maine et Loire.—M. Andouard.—Of local interest only.

The remainder of this number of this periodical is filled with abstracts from the *Comptes Rendus* and other papers already noticed by us.

Journal für Praktische Chemie, No. 5, 1869.

This periodical contains, in the first place, three papers, by the late Professor Schönbein, on the following subjects:—

1. Peroxide of Hydrogen as a Medium for Recognising the Ferment-like Properties of Organic Matter.

2. Peculiar Activity of One-Half of the Oxygen Contained in Oxide of Copper, and the Dependence thereupon of a Highly Delicate Reagent for Hydrocyanic Acid and Cyanides.

3. Existence of Peroxide of Hydrogen in the Atmosphere.

We regret that the above essays, though highly interesting, are too long for abstraction; perhaps we may, at a future day, give abbreviated translations of some of them.

On Hydrocarbons.—M. Fritzsche.

On Benzol.—M. Rochleder.

On Catechin and Catechutannin.—M. Rochleder.

Behaviour of Narceïn towards Iodine.—M. Stein.—The author has found that narceïn is coloured blue by iodine, but only when the alkaloid is in a solid state; for as soon as the crystals of narceïn become dissolved, the colouration disappears. None of the other alkaloids of opium behave in the same manner with iodine.

Analysis of an Alloy found at Pompeii.—M. Milan Nevole.—Specific gravity of alloy, at 13° C, 6·66. It contained, in 100 parts:—Silica, 0·08; lead, 1·12: copper, 55·04; iron, 29·56; antimony, 3·53; zinc, 10·67.

Decomposition of Disulphide of Carbon by Heat.—M. W. Stein.—The author states that the vapour of perfectly pure disulphide of carbon, prepared on purpose for this experiment, was not decomposed when passed through a porcelain tube kept red hot by a Bunsen gas burner; but, on repeating the experiment, and increasing the heat, by the application of a strong coke and charcoal fire, the inner space of the tube having been filled with broken porcelain, it was found to be lined with a deposit of carbon, owing to the decomposition of the sulphide, while sulphur was collected in a receiver.

Isocitric Acid.—M. Rochleder.—This acid is formed when citric acid in aqueous solution is treated with sodium amalgam, care being taken to keep up an acid reaction of the liquid by the addition of dilute sulphuric acid. The isocitric acid may be obtained pure by a rather circuitous process, and then exhibits a crystalline mass, which has not yet been further investigated; neither have any of the salts it forms been studied.

Polytechnisches Journal von Dingler, second April number, 1869.

This periodical, though chiefly bearing upon mechanical science, occasionally contains original communications which are interesting to our readers; from the present number we only abstract:—

Very Durable Cement for Iron and Stone.—M. Pollack, of Bautzen, Saxony, states that, for a period of several years, he has used, as a cement to fasten stone to stone, and iron to iron, a paste made of pure oxide of lead, litharge, and glycerine in concentrated state. This mixture hardens rapidly, is insoluble in acids (unless quite concentrated), and is not affected by heat. M. Pollack has used it to fasten the different portions of a fly-wheel with great success; while, when placed between stones, and once hardened, it is easier to break the stone than the joint.

First May number, 1869.

The greater number of the papers of the present number relate to mechanical science; we notice briefly:—

Diaphonometer to Determine the Transparency of Different Kinds of Glass.—M. Jicinsky.—Without the engravings, it is impossible to make this instrument understood, but, from what is said about it, it is no doubt a useful instrument, especially as the author has proved that the diaphanicity of divers kinds of glass is not dependent so much on its chemical composition, as on certain physical properties due to the heat applied in making it.

Improvement of Acid Waters often Pumped up from Coal-pits and Mines.—Dr. Willigk.—The author had an opportunity to analyse a water pumped up from a coal-pit in Bohemia. This water, it appears, was very acid, from acid sulphates and some free sulphuric acid present therein, consequently attacking and corroding the pumping gear and machinery, and seriously affecting the steam boiler wherein it had to be used. No other feed-water being on the spot, the author advised, and with good success, that the water should, previous to use, be filtered over witherite, carbonate of baryta, which happened to be abundantly present in that locality.

Analysis of a Cement Marl.—Dr. Lindenmeyer.—In 100 parts:—Lime, 36·84; carbonic acid, 28·50; silica, 23·24; alumina, 4·30; peroxide of iron, 1·14; magnesia, 0·96; potassa, 1·48; water, 2·45. Of this quantity, 29·16 per cent was insoluble in hydrochloric acid.

Volumetrical Estimation of Sulphuric Acid.—Dr. A. Clemm.—After reviewing the methods of R. Wildenstein and Carl Mohr, applied for this purpose, the author describes his mode of operating at length. Briefly stated, his method is the following:—The solution to be experimented upon is coloured with litmus, and very carefully neutralised; a solution of chloride of barium of known strength is added in excess, and all the sulphuric acid thereby precipitated. Next, a titrated solution of carbonate of soda is added, in order to precipitate the excess of baryta; and next, again, the excess of soda solution used is estimated, volumetrically, by means of a titrated dilute sulphuric acid. During these operations, no salt is formed which can injure the colour of the litmus. In case salts might be present in the original solution, the bases of which could be precipitated by carbonate of soda, that precipitation is performed previous to the addition of soda. The filtrate, which contains the sulphuric acid combined with soda, is neutralised, and again volumetrically titrated. The solutions required for this experiment are:—A solution of chloride of barium, containing 52 grms. to the litre of water; a solution of carbonate of soda, containing 26·5 grms. of this salt to the litre of water; a solution of sulphuric acid, containing 20 grms. of strong sulphuric acid to the litre of water. These solutions agree among each other, drop for drop. The advantage claimed for this method is the non-necessity of having to wash out the sulphate and carbonate of baryta, and also the advantage that titration does not take place in a fluid rendered turbid by therein-suspended sulphate of baryta, which always tends to render the observation of colouration of litmus more difficult.

Experiments on the Direct Decomposition of Sulphide of Calcium as met with in Soda Waste by means of Chloride of Manganese.—Dr. Richter.—The author has instituted experiments with the view to obtain, directly, the sulphur in such a state as to render its

extraction, by means of sulphide of carbon, an easy matter. Although he has not succeeded quite so well as he desired, he says he hopes his experiments will be repeated by others on a larger scale.

Cryolite Glass, or so-called Hot-Cast Porcelain.—M. Benrath.—The specific gravity of a sample obtained by the author, director of the Imperial Russian Plate-Glass Works at Dorpat, from the American Hot-Cast Porcelain Company, was found to be 2·471. Composition, in 100 parts:—Silica. 67·07; alumina, 10·99; peroxide of iron, 1·02; protoxide of manganese, 1·09; lime, traces; soda, 19·38.

Annalen der Physik und Chemie, von J. C. Poggendorff, No. 3, May 15, 1869.

This periodical contains the following original essays, chiefly relating to mathematico-physical subjects, and hence too abstruse for abstraction:—

Construction of Galvanometers to be applied when Electric Discharges take place, and on the Way Followed by Electric Co-Currents (Nebenstrome).—M. E. Edlund.

Compounds of Tantalum and Niobium.—M. Rammelsberg. This is the concluding portion of a lengthy essay on this subject.

Reproduction of Siemens's Unit of Resistance.—M. von Dehms.

Mineralogical Miscellany.—M. von Rath.—*Angles of the Vivianite System.—Chemical Formula of Silicate of Bismuth.* Eulytin contains, in 100 parts:—Oxide of bismuth, 69·38; silica, 22·23; phosphoric acid, 3·31; peroxide of iron, 2·40; oxide of manganese, 0·30; hydrofluoric acid and water, 1·01; total, 98·63 The specific gravity of this mineral, at 17° C., is 6·106; formula, according to this author—

$$6BiO_2Si_2O_2 + \left\{\begin{matrix} BiO_2 \\ Fe_2O_2 \end{matrix}\right\} PO_2 + BiFl.$$

Crystalline Form of Atelestite.—Labradorite from Närödal, near Gudvangen.—Boulangerite from the Argentiferous Sand near Mayen.—This mineral is made up according to the formula $3PbS,Sb_2S_3$, and contains, in 100 parts:—Sulphur, 18·21; antimony, 22·83; lead, 58·96.—*New Crystalline Alloy of Zinc and Calcium.* This alloy contains, in 100 parts:—Zinc, 95·13; calcium, 4·87. Formula, $Zn_{13}Ca$; crystalline form, quadratoctahedron; specific gravity, 6·3726; when in contact with water, hydrogen is at once disengaged by this alloy.

Collections of Meteorites.—M. Buchner.

New Sulpho-Salts.—M. R. Schneider.—Sulphide of potassium and iron, $K_2Fe_2S_4$, in 100 parts:—Potassium, 24·59; iron, 35·19; sulphur, 40·22. Sulphide of potassium and bismuth. $K_2Bi_2S_4$, in 100 parts:—Potassium, 12·57; bismuth, 66·85; sulphur, 20·58.

Galvanic Relation of Palladium.—M. Poggendorff.

Simple Expressions for the General Fundamental Principles of Electric Action.—M Weber.—A mathematical essay.

Galvanic Resistance of Liquids.—M. Paalzow.

Mineral met with in the Baryta-Bearing Gangue of Wittich, in the Duchy of Baden.—M. Petersen.—Analysis of *Wittichenite.* Specific gravity, 4·45. It contains, in 100 parts:—Sulphur, 20·30; arsenic. 0·79; antimony, 0·41; bismuth, 41·13; iron, 0·35; copper, 36·76; silver, 0·15; zinc, 0·13.—*Epigenite.* In 100 parts:—Sulphur, 31·57; arsenic, 12·09; bismuth, 2·12; iron, 13·43; copper, 40·32; traces only of silver and zinc.—*Magnetic Pyrites*, in hornblende.—In 100 parts:—Sulphur, 39·93; arsenic, 0·15; lead, 0·10; copper, 0·36; iron, 58·31; nickel and cobalt, 0·63; with traces of titanium, manganese, bismuth, and minute traces of silver.

Specific Gravity of Basaltic Lava.—Dr. A. von Lasaulx.—It appears that this material varies in specific gravity from 1·93 to 2·79. Eight different samples were operated upon, all of which had been previously reduced to a finely divided powder.

Pharmaceutische Zeitschrift für Russland, March and April, 1869.

We take these two numbers together, since the leading original paper contained therein is carried through both these numbers. The paper is an essay, bearing the title—

Glycerine: its History, Manufacture, Occurrence, Estimation of Purity, and Various Applications.—J. W. Klever.—Glycerine is met with in some natural oils and fats, also in the products of the vinous fermentation of sugar; hence it is found in wine in small quantity. It does not occur in fats as such by itself; these substances are to be considered rather as ethers. 100 parts of glycerine dissolve of—Arsenious acid, 20 parts; benzoic acid, 20 parts; oxalic acid, 15 parts; bicyanide of mercury, 27 parts; corrosive sublimate, 7 50 parts; alum, 40 parts; arseniate of potassa, 50 parts; sulphur, 0·10 parts; strychnia, 0·25 parts; morphia, 0·45 parts; acetate of morphia, 20·0 parts. The following substances are insoluble in glycerine:—Ether, benzol, camphor, sulphide of carbon, chloroform, the bromide and iodide of mercury, calomel, fatty acids, fatty and ethereal oils. Glycerine, is decomposed by chromic acid, bichromate of potassa, and permanganate of potassa.

On the Microscope, and the Discoveries made by it.—M. O. Löwenthal. This paper contains a short history of the discoveries made by this useful optical instrument, from Antony van Leeuwenhoek's time down to the present age.

Testing Chloroform for the Presence of Alcohol and Ether.—The chloroform should be first treated with fused chloride of calcium, to eliminate any water, next some iodine should be added. If the chloroform is free from either alcohol or ether, the colour produced by the solution of the iodine is bright red; but when either alcohol or ether are present, the colour of the solution is brown. In order to distinguish between alcohol and ether, a small piece of a crystal of fuchsin is added to the chloroform in question; when the slightest trace of alcohol is present, a deep red solution will ensue. Perfectly pure chloroform yields, with fuchsin, a solution which is only slightly pinkish tinged.

Salt Deposit near Berlin.—M. Jahn.—It appears that there has been discovered near Berlin, at Sperenberg, a rock salt deposit, which in some localities has a thickness of 669 feet. The locality where this important discovery has been made is within eight miles from the capital city of Prussia, and, from borings instituted, it appears, in every respect, a highly valuable mineral deposit.

Non-Identity of Caffeine and Theine.—M. Hager observes that, although elementary chemical analysis of these substances yields results which would conclusively prove the identity of these two substances, yet the author found that the physiological effect, after partaking of a dose of 0·25 grm. of both substances, in chemically pure state, and prepared by himself, is by no means the same. The human organism is imbued with testing powers, compared with which chemical reagents are of little delicacy.

On the Ground Nut, Arachis Hypogœa.—M. F. A. Flückiger.—This is a monograph on the subject, and includes the origin, discovery, occurrence, and commercial history of the fruit of a plant belonging to the natural order of the *Leguminosæ*. The fruit is known, in English language, as ground-nut, earth-nut, pea-nut, and manilla-nut; in French as *arachide* or *pistache de terre*. The plant which yields this fruit is a native of tropical and sub-tropical regions, and belongs especially to Africa. The average weight of the seeds contained in the fruit and bearers of the oil is 0·5 grm.; they yield from 38 to 50 per cent of oil, which consists of

a mixture of glycerine compounds and three different fatty acids—arachinic acid, $C_{40}H_{10}O_4$, fusing at 75° C.; hypogœic acid, $C_{32}H_{30}O_4$, fusing at 35° C.; and palmitinic acid, $C_{32}H_{32}O_4$, fusing at 62° C. The seeds contain 28·85 per cent of protein compounds, 13·87 per cent of woody fibre, and 7·16 per cent of gum and sugar.

Sensitiveness of Divers Methods for the Detection of Arsenic.—M. Frank.—Marsh's apparatus admits of detecting 0·0003 milligramme AsO_3, dissolved in 150,000,000 of its weight of liquid; the method of Von Babo and Fresenuis admits of detecting 0·002 milligramme AsO_3; Reinsch's method, by means of copper, detects 0·001 milligramme AsO_3, in 5,000,000 as much liquid; Rieckher's method, by means of ammoniacal nitrate of silver solution, detects 0·002 milligramme in 3,000,000 parts of liquid.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 8/ May 8, 1869.

We notice, in the brief report of the general meeting of the 26th of April last, under the presidency of Professor A. W. Hofmann, that the committee of this Society had arranged and approved of the proposal of M. Scheibler, that a photographic album be made to contain the photographic portraits of the members of the *Gesellschaft*, taken in the well-known card size, and each photograph to bear, moreover, the autograph of the member it represents. At the ordinary meeting of the Society, held on the same day, the following papers were read:—

Simple Method for Determining the Percentage of Water contained in Various Kinds of Starch.—M. C. Scheibler.—The author states that he had been requested by a number of starch and glucose manufacturers to try to find a readily-executable, yet reliable method of determining the quantity of water contained in starch, especially in its green, or raw state. M. Scheibler further says, that it occurred to him that, since starch is insoluble in alcohol, and only contains very slight traces of fatty matter, the object to be obtained might be readily attained by determining the change of the specific gravity alcohol suffers after having been for a length of time in contact with wet starch. In order to test this point practically, some preliminary experiments were first made with starch and alcohol of 90° Tralles (equal to 0·8339 specific gravity at 12 4-9ths degrees R.), and afterwards the following mode of testing was devised:—100 c.c. of the alcohol, weighing 83·4 grms., were placed in a glass-stoppered bottle, and thereto was added 41·7 grms. of divers samples of starch, in separate samples, of which the quantity of water therein contained had been previously ascertained with great accuracy. These samples were left in contact with the alcohol for one hour, care being taken frequently to shake the bottle. After that lapse of time, the alcohol was separated from the starch by filtration, and its specific gravity accurately determined. While experimenting, the author observed that, when the starch contains less than 11·4 per cent of water, instead of yielding up water to alcohol of the above-named strength, it withdrew water from that alcohol. The lengthy paper contains several tabulated forms, and is, on the whole, intended especially to aid starch and glucose makers in their business, and the experiments refer to so-called green starch.

Essay on the Affinity in Solutions of Perchloride of Iron, without Change of the State of Aggregation.—M. A. Müller.—The author says, in the introduction to his paper:—Only when the intensity of a coloured solution decreases, by dilution, in the inverse ratio of the increase of bulk, are we entitled to assume that the molecules of the colouring material are simply mechanically put asunder, and not also chemically modified; when, however, the intensity of colour is affected, in a more or less degree, in a different manner, by becoming more dilute, we are almost forced to assume a chemical change. The author next states that, from experiments made by him, and with solutions of chloride of iron and other coloured metallic chlorides, platinum chloride being preferred, he has found that the intensity of the colour of the solution really depends—1st, on the nature of the diluent; 2nd, on the temperature of the solution; and, 3rd, on the age of the solution—*i.e.*, whether recently prepared or not. As diluents, have been applied—water, hydrochloric acid, solution of chloride of ammonium, and solution of chloride of sodium. The experiments made are described at great length. It appears that the addition of hydrochloric acid, chloride of ammonium, and chloride of sodium have the effect of increasing the intensity of colour of a solution of chloride of iron, even after it has been largely diluted with water; increase of temperature has the same effect.

Varying Behaviour of Iodine towards Sulphuretted Hydrogen under Different Condtions, and the Causes thereof.—M. Naumann.—When iodine is dissolved in perfectly anhydrous sulphide of carbon, and dry sulphuretted hydrogen is passed into that solution, no action whatever takes place. Water, as well as an increase of temperature, are required for the formation of hydriodic acid and the separation of sulphur. The author has gone at great length in studying both the thermic and hydric conditions, which are called into play when the two substances alluded to react upon each other; and, in the second part of his paper, discusses—

The Preparation of an Aqueous Solution of Hydriodic Acid.—Several experiments have been made on this subject, and, as result thereof, the author recommends that, first, a concentrated solution of iodine in pure sulphide of carbon be made; this solution to be next diluted with more of the latter fluid, and then only water to be added, previous to the passing of sulphuretted hydrogen gas into the solution.

Essential Oil of Balsam of Peru.—M. Kraut.—The author found that this oil may be separated, by distillation under reduced pressure, and in an atmosphere of carbonic acid gas, into three different oils:—*a*. Boils at 200° C.; contains 76·20 per cent C, and 6·68 per cent H; and is converted, by chromic acid, into benzoic acid, no carbonic acid becoming disengaged. *b*. Boils at 300°; contains 79·09 per cent C. and 6·00 H; an alcoholic solution of potassa converts this oil into benzoic acid and benzylic alcohol. *c*. Boils at about the boiling point of mercury; contains 81·21 per cent C, and 6·12 H; treated with alcoholic solution of potassa, it is converted into cinnamic acid and benzylic alcohol.

On Cumonitrilamine.—M. E. Czumpelik.—The author describes at great length a series of experiments made by him to prepare this base; the description being too complicated for abstraction, we content ourselves with giving the ultimate result of his labours. Cumonitrilamine is a solid substance, readily crystallising, difficultly soluble in water, but readily so in alcohol and ether; fuses at 45° C.; and boils at 305° C. With acids, salts are formed, and with chloride of platinum a beautifully-crystalline double salt is obtained. The elementary organic analysis of this salt gave, in 100 parts, the following result:—C, 32·74; H, 3·54; N, 7·68; Pt, 26·97; Cl_6, 29·07. These numbers lead to the following formula:—

$$C_{20}H_{26}N_4PtCl_6 = 2\,[C_{10}H_{12}N_2HCl].PtCl_4.$$

The equivalent of this platinum compound is 733.

Base of the Cumin Series, which agrees with Benzylamine.—M. E. Czumpelik.—In this paper, the author tells us how he effected the hydrogenisation of the cumonitrile. While obtaining various intermediate products, he at last got thioamide, an oily liquid, yielding, with hydrochloric acid, a readily crystallisable salt, which combines with chloride of platinum, yielding a crystalline compound, insoluble in water, and soluble in alcohol and ether. This, on being submitted to elementary organic analysis, gave the following results for 100 parts:—C, 33·78; H, 4·15; N, 3·94; Pt, 27·18; Cl_6, 29·95. Formula—

$$C_{20}H_{22}N_2PtCl_6 = 2[C_{10}H_{11}N,HCl]PtCl_4.$$

The equivalent of this platinum compound is 711.

On Trimethylglycerammonium.—M. V. Mayer.—By a complicated set of reactions between substances, the very length of the names of which would occupy too much space, the author succeeded in obtaining a double gold salt of the base named at the head; this salt—

$$AuCl_2N(CH_3)3C_3H_5(OH)2Cl,$$

that is to say, the trimethylglycerammonium chloride of chloride of gold exhibits orange-coloured, very lustrous crystals, soluble in water, as well as in absolute alcohol, and fuses at 190° C. The trimethylglycerammonium chloride is a solid substance, crystalline, soluble in water, and decomposed, by boiling with baryta water, into trimethylamine. The author states that his researches on the trimethylglycerammonium, in free state, are not yet quite complete.

On the Means of Entirely Preventing Bumping of Fluids while Boiling.—M. E. Winkelhofer.—The author reviews what has been done by others, and especially by Dr. Pellogio, and next describes, at length, some experiments of his invention, embracing the following fluids:—Methyl-alcohol, sulphuric acid, alcoholic solution of sulphate of protoxide of iron, alcoholic potassa solution, hydrochloric acid, and dilute sulphuric acid, containing some sulphate of lead. His plan, to prevent bumping, is simply an electric current, led into the fluids by means of suitable conducting wires; his contrivances are very ingenious, but certainly too complicated for general use.

Hypotheses respecting the Constitution of Benzol.—This paper cannot be well understood without the diagrams annexed thereto, upon the value of which the reasonings contained in the paper are based.

This number of the *Berichte* concludes with a brief notice, by M. Rammelsberg, correcting some of Mr. Maskelyne's statements in respect of a meteorite and minerals found therein, and the specific gravity of these minerals. Maskeline observed in a meteorite from Breitenbach in Bohemia, occupying a middle place between iron and stone meteorites, a mineral embedded in the iron, of 3·3 sp. gr., and having the composition of enstatite. He found another mineral, which yielded, on analysis, from 97 to 99 per cent of silica, and only having the low sp. gr. of 2·1 to 2·2, and is therefore not quartz; Maskelyne says it is optically doubly axial, and takes it as identical with tridymite, which, however, has a sp. gr. of 2·3, and is optically uni-axial.

Der Papier Fabrikant, No. 5, May, 1869.

This periodical, published in Southern Germany, is not a mere trade circular, but a very well got up paper; and, in the present number, an interesting paper is met with on a subject not quite familiar to scientific, and less so to many practical readers, in this country. We abstract some of the leading features of a valuable paper—

On Ultramarine.—M. Zuber.—The beautiful blue pigment now known as ultramarine, and manufactured in France and Germany on a large scale, has become common by the results of scientific and analytical chemistry. The native ultramarine, also called lazulite, lapis lazuli, and zeolite blue, is a rather rare mineral, of which, in pure state, according to Patrin, Central Asia is the native place. This native mineral consists, in 100 parts, according to Varrentrapp's analysis, of:—Silica, 45·40; alumina, 31·67; soda, 9·09; lime, 3·52; sulphuric acid, 5·89; sulphur, 0·95; iron, 0·52; chlorine, 0·42; water, 0·12. According to Field, the formula for this mineral is—

$$6[3SiO_2.NaO.Al_2O_3],FNaS.$$

The finest specimens of native ultramarine are used as precious stones; and some of it is still used by artists, it being prepared for that purpose, in a peculiar manner, chiefly at Rome and Florence. Artificial ultramarine was first made by a process discovered by M. Guimet, in France, in 1826, but kept secret, and remaining so up to the present day. Although the pigment obtained by artificial means is *one of great beauty and permanency*, under ordinary conditions it is never made equal to the pigment derived from the native *lapis lazuli*. Notwithstanding a large number of scientific and practical men have studied this subject, the precise answer to the question, whence the blue colour of this substance is derived from, is a perfect mystery; the only fact certainly known is, that a portion of the sodium is combined with the sulphur, to form a certain sulphuret, and that that alkaline sulphuret is chemically combined with a double silicate of alumina and soda. Iron and calcium have been proved to have nothing to do with the cause of the blue colour, and to be simply accidental. In the original paper, from which we condense the results, no less than 10 analyses of samples of artificial ultramarine, made by different analysts, and from different makers, are given. Varrentrapp's results are, for 100 parts, as follows:—Silica, 46·60; alumina, 23·30; soda, 21·46; sulphur, 1·68; potassa, 1·75; iron, 1·06; lime, 0·02; sulphuric acid, 3·08; with traces of chlorine, oxide of iron, oxygen, and an accidental trace of clay. The ingredients required for the manufacture of artificial ultramarine are—sulphur, wood charcoal, sulphate of soda, carbonate of soda, and kaolin; curiously enough, the latter substance is preferred from Cornwall, and fetched thence to be transported abroad, while the manufacture of ultramarine in this country is of little or no importance. The product of ultramarine met with in commerce is rarely, if ever, adulterated, unless it be with the pure sulphates of lime and baryta, to reduce the original deep blue colour to a less dark shade. In order to test the colouring value of a sample of ultramarine, it is usual to weigh off 0·1 grm., and to mix it, in a dry state, with 1 grm. of powdered French chalk, and to compare the tinge obtained with other mixtures of the kind and a standard sample of ultramarine. Besides being largely used in oil painting, ultramarine yields blue printing ink, blue for calico, silk, and woollen tissues; for colouring paper, sugar (it is largely used in sugar refineries to brighten the loaf sugar), fresco and stucco painting, and other purposes. All acids, especially the more concentrated ones, destroy the colour, which, however, stands fire, as well as many other agents. The native ultramarine is not affected by acids unless heat is at the same time applied.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, February, 1869.

None of the papers contained in this periodical bear upon chemical science, or subjects more immediately connected therewith.

Annalen der Chemie und Pharmacie, May, 1869.

This periodical contains the following original essays and papers:—

On Indium.—M. R. E. Meyer.—The author opens his lengthy essay with a review of the labours of others on this subject. He then states that the source whence he extracted indium is the zinc from Freiberg, in Saxony. The preparation of the metal, and its purification, are described at great length, but, since no new method was applied, we need not enter into details on this subject. The various combinations of this metal with iodine, bromine, chlorine, cyanogen, sulphuretted hydrogen, and, next, salts of the oxide, are described. The iodide of indium, InI_3, equivalent 329·6, contains, in 100 parts:—Indium, 22·94; iodine, 77·06. The chloride of Indium, $InCl_3$, equivalent 146·6, contains, in 100 parts:—Indium, 51·57; chlorine, 48·43. A large number of double salts and compounds of the halogens of indium, with similar compounds of other metals forming double halogen compounds, are described in detail; in fact, the essay is an exhaustive monograph on this subject.

On Lactic Acid and β Iodpropionic Acid.—M. Socoloff.—This essay is a review rather of what has been done on this subject by other experimenters, than an ac-

count of the author's own labours. He states that the β iodpropionic acid was prepared by him in the same manner as was done by MM. Beilstein and Moldenhauer. Several salts of this acid were prepared by M. Socoloff, and submitted to organic elementary analysis. The calcium salt yielded, in 100 parts:—Carbon, 33·08; hydrogen, 4·62; calcium, 18·34; the remainder being oxygen. In a tabulated form, the author records the physical properties of the calcium, barium, zinc, and lead salts of the acid submitted to research by him, and of ordinary lactic acid, paralactic acid, and methylglycolic acid. The lengthy essay winds up with a theoretical discussion on mono-acid, bin-acid, and even hepta-acid alcohols.

Researches on the Derivatives of Salicine.—M. Hugo Schiff.—This paper is the first of a series to be continued by the author on this subject, and this portion is headed—I. *Amide of Salicyl Aldehyde.* The author begins by stating that the formula for the aldehyde of salicyl should be written—

$$C_6H_4\begin{cases}OH\\CHO'.\end{cases}$$

Next, the preparation of this aldehyde is described as follows:—Take, from 300 to 400 grms. of salicine, and the Ettling oxidation mixture (nothing is said as to what this mixture consists of); during the time the distillation is going on, water is allowed to drop continuously into the retort, in order thereby to keep up the original degree of concentration of its contents, and to prevent the formation of resin as much as possible. The aldehyde, after having been separated from the water, is saturated with common salt, and mixed with ether; in this manner, about one-third of the weight of the salicine originally taken is obtained as aldehyde. The author next treats of the products of the action of aniline upon salicyl-aldehyde, and then describes, at great length, several complicated combinations, as, for instance, salhydrethylanilide, formula—

$$C_6H_4\begin{cases}OH\\CH.\end{cases}\begin{cases}NC_2H_5.C_6H_5\\NC_2H_5.C_6H_5\end{cases}=C_{32}H_{32}N_2O;$$

ethylsalhydranilide—

$$C_{12}H_{15}NO;$$

and ethylsalhydrethylanilide—

$$C_{26}H_{20}N_2O.$$

Several metallo-compounds are next described—Copper salhydranilide—

$$C_{26}H_{20}CuN_2O_2,$$

containing, in 100 parts:—Carbon, 68·2; hydrogen, 4·6; copper, 13·7.

Derivatives of Propane.—M. Carl Schorlemmer.—Propane, a hydrocarbon, C_3H_8, is described, first, as regards its preparation from isopropyliodide and zinc turnings; next a chloride of propane is prepared, which, on being analysed, yielded results leading to the formula C_3H_7Cl. The author describes several experiments, made with the view to obtain chemically pure products, and ends his paper by promising more accurate and full details on this subject.

On Hydroxylurea.—Drs. Dresler and Stein.—When hydroxylamine and cyanic acid act upon each otner, a substance is obtained, the composition of which may be expressed by the formula $N_2CH_4O_2$. The authors state how they proceeded to obtain this substance, in a pure state, by a rather complicated and lengthy process. The hydroxylurea is a solid substance, very soluble in water, sparingly in alcohol, crystallising in needle-shaped crystals; it fuses at 130° C., and is decomposed when that temperature is continued, yielding carbonic acid and ammonia. The substance is readily acted upon by caustic potassa and nitric acid; its solutions, in neutral fluids, reduce solutions of salts of silver to the metallic state.

Comptes Rendus des Séances de l'Académie des Sciences. Monday, May 31, 1869 (No. 22).

We notice, in the first place, an abstract of a memoir—

Decomposition of Chloride of Sodium and Chloride of Potassium by Metallic Iron under the Influence of Moist Air.—M. E. Chevreul.—After having entered upon some historical details, and gone back as far as the year 1779, when Scheele experimented on this subject, he proves, by a simple experiment made before the meeting, that, when chloride of sodium, iron, water, and air are in actual contact, decomposition of the alkaline chloride takes place; further, that this decomposition is not, as has often been stated, an effect of efflorescence, but a double decomposition, according to the well-known law of Berthollet, which, however, was rather too vaguely formulated by its original author.

New Spectrum Observations of the Sun's Atmosphere and Protuberances.—Rev. Father Secchi, S.J.—In the shape of a letter, addressed from Rome, and dated May 21st, the eminent *savant* states:—The spectrum observations of the solar protuberances made by M. Rayet, during the eclipse of the sun, in the month of August last year, have revealed a considerable number of luminous rays, seven of which were especially prominent; only four of this number have afterwards, when no eclipse takes place, been found to exist with certainty—viz., the three principal rays of hydrogen, and the yellow ray in the neighbourhood of sodium. It was highly interesting to try whether, under favourable conditions, these three other rays could be again found. I am happy to be able to state that, during my observations yesterday (May 20th), I have succeeded in seeing these rays with perfectly absolute certainty. The author proceeds to describe the exact locality where he discovered these rays, and gives a diagram to illustrate this portion of his letter; and next describes the nature of these rays at length, illustrated by a diagram. It appears, from this description, that the rays exhibit great brilliancy, and are more remarkable, even than could be expected at first from M. Rayet's former observation. The rays are those of magnesium, hydrogen, and a none-gaseous (as yet undetermined) substance.

Scientific Aerostation.—M. Tissandier states that a balloon, of 10,000 cubic metres (about 354,000 English cubic feet) capacity, and of 2500 square metres surface, has been placed, by M. le Ministre de la Guerre, at the disposal of several scientific men, and that it is intended to have (on June 27th and July 11th ensuing, from the Champs de Mars, Paris) ascents with this balloon, the car of which is capable of carrying with comfort ten people, and, in addition, 1500 kilos weight. Members of the Academy desirous of being of the party are requested to state so. This balloon is formed of four layers of tissue, glued together by means of india-rubber, and is to be filled with hydrogen; and experiments already made have proved that it preserves that gas unaltered for a long time.

On a new Thermo-Electric Battery made with Galena.—MM. Mure and Clamond.—This battery is composed of sixty elements, made up of small bars of galena, 40 m.m. in length by 8 m.m. thick, and bars of thin sheet iron, 55 m.m. in length by 8 m.m. in width, and 0·6 m.m. thickness. These materials have been arranged so as to form a hollow cylinder, which, when it is intended to be used, is to be heated by a peculiarly constructed gas burner. The specimen of this battery exhibited at the meeting had an electro-motive force of 1½ Bunsen element. M. Becquerel read a lengthy paper on the subject of this battery, the result of which is, that thermo-electric batteries, constructed either of metallic alloys, or as in this case, of a metallic sulphide and a metal, are not economical in use, and are too liable to changes brought on by the effects of the heat.

The Law of Mariotte, and on the Liquefaction of Gases in Relation to the State of Dryness of these Gases.—M. Dubrunfaut.—Curiously enough, and in spite of, and against all evidence to the contrary, the ant

insists that perfectly pure and dry gases cannot be liquefied by any pressure or any lowering of temperature, however great. He says, the intervention of water is an absolute condition of the condensation of gases to fluids; no wonder that M. Dumas should vehemently protest against a heresy so flagrantly in opposition with experience.

Chemical Constitution of Amylaceous Matter.—M. Musculus.—The author has made a series of experiments, in order to prove that the formation of dextrine from starch is only the first step in the process of splitting up which starch undergoes when it is placed in contact with water and diastase at a temperature of from 60° to 75° C., and that the quantity of sugar obtained by this process represents at least two equivalents. The lengthy paper contains the results of a series of experiments, too long and too many to be further quoted here, but the author has to confess that his main object has not been attained.

Researches on the Ethers of Phenol.—M. E. Lippmann.—The author has studied—*Ethylen-diphenol*—

$$\left.\begin{matrix}(C_6H_5)\\C_2H_4\end{matrix}\right\}O_2.$$

Ethylen-diphenolsulphuric Acid.—The lead-salt of this acid crystallises, and is soluble in hot water, but insoluble in cold water. The analysis of the salt, dried at 120° C., gave, in 100 parts—C, 29·49; H, 2·0; Pb, 35·7. Formula—

$$\left.\begin{matrix}C_6H_4SO_3Pb''\\C_6H_4SO_2\\C_2H_4\end{matrix}\right\}O_2.$$

Ethylen-diphenosulphate of Barium.—A crystalline powder, not very soluble in boiling water. Its elementary organic analysis gave, for 100 parts:—C, 33·0; H, 2·3; Ba, 26·9. Tetrabromide of ethylen-diphenol is composed, in 100 parts, of:—C, 31·6; H, 2·0; Br, 60·3. Formula—

$$\left.\begin{matrix}C_6H_3Br_2\\C_6H_3Br_2\\C_2H_4\end{matrix}\right\}O_2.$$

The author states that the preliminary note from M. Burr on this subject, published in the *Zeitschrift für Chemie*, No. 6 (see Chemical News, vol. xix., p. 251), had not come into his possession when he made his experiments.

New and General Method for the Preparation of Nitriles.—M. L. Henry.—The author has succeeded in transforming amides into nitriles, by means of pentasulphide of phosphorus, and has especially operated upon acetamide and benzamide, making use of 1 equivalent of the pentasulphide of phosphorus upon 5 equivalents of the amide. The result of the action of the pentasulphide of phosphorus upon acetamide is aceto nitrile, $(C_2H_3)N$; while the result of the action of this material upon benzamide, is cyaphenine, a polymere of benzonitrile, $(C_7H_5)N$.

Physiological Effects of Stanethyl and Stanmethyl.—MM. Jolyet and André Cahours.—The authors describe the preparation of these chemical compounds which may be obtained by means of the perchloride of tin, Sn_2Cl_4, at great length, and then describe the physiological effects, which are those of stupor, inducing narcotism in the very highest degree.

No. 23, June 7, 1869.

We notice, from this periodical, the following memoirs, papers, and communications, omitting those relating to physiology, medicine, mathematics, and mechanical science:—

Synthesis of the so-called Aromatic Acids.—M. Wurtz.—The author describes, in the following terms, a new method for the synthesis of the above acids:—When an organic chloride, or bromide, is treated with chloroxycarbonic ether and sodium amalgam, the haloid element is eliminated by the sodium, and replaced by the group $CO_2(C_2H_5)$; if it is, therefore, required to convert a carbide of hydrogen into a higher monocarbon acid of the series, the monochloride or monobromide of that carbide of hydrogen is first prepared, and then heated with chloroxycarbonic ether and sodium amalgam. The author next proceeds to describe some experiments made by him, and the results obtained, at length; starting with bromide of phenyl, C_6H_5Br, and mixing this chloroxycarbonic ether and sodium amalgam, the following formula represents the reaction, resulting in the formation of benzoic ether:—

$$C_6H_5Br + CO\left\{\begin{matrix}O.C_2H_5\\Cl\end{matrix}\right. + Na_2 = NaCl + NaBr + C_6H_5.CO_2(C_2H_5).$$

Use of the Spectroscope to Distinguish a Feeble Light, Present with a Stronger Light.—M. Seguin.—The author describes a series of experiments with electric light, and observations thereon with Duboscq's vertical spectroscope. The result and conclusion arrived at is, that the spectroscope serves eminently the purpose of detecting (proved, also, by the other observations made with it of the sun's light and protuberances) a more feeble light present along with a much stronger, and the former of which would be invisible to the naked eye, or by means of other optical instruments.

On Acetochlorhydrine and Octylglycol.—M. de Clermont.—Into 50 grms. of anhydrous acetic acid, strongly cooled, anhydrous hypochlorous acid is passed, until the acetic acid has absorbed 10 grms. of the latter; no stronger solution should be made, as there is danger of explosion. To the mixture of acetate of chlorine and anhydrous acetic acid is added a quantity of 14 grms. of pure octylen, previously mixed with anhydrous acetic acid; acetochlorhydrine is thus formed, which, being held in solution by the acetic acid, is separated therefrom by addition of water. The acetochlorhydrine of octylen is a highly mobile liquid, devoid of colour, of agreeable and aromatic odour, soluble in alcohol, ether, and acetic acid, insoluble in water, burns, when ignited, with a sooty greenish-bordered flame, and boils, without decomposition, at 225° C. The specific gravity of this liquid is, at 0° C., 1·026, and it consists, in 100 parts, of:—C, 58·11; H, 9·20; Cl, 17·19. Density of vapour, 7·12.

Acetic Derivatives of Mannite.—M. E. Grange.—When crystallised mannite is heated, in an open vessel, with strong acetic acid, and boiled, there is left, on cooling, a crystalline mass embedded in a syrupy liquid; the latter is separated by filtration over asbestos, and the dry solid residue washed with strong absolute alcohol, to eliminate the acetic acid. The material, thus purified, is hardly soluble in alcohol, not at all in ether, and very soluble in water and acetic acid. Submitted to analysis, it yields, in 100 parts:—C, 45·42; H, 7·027; O, 47·553; corresponding to the formula $C_{14}H_{26}O_{11}$, equal to $C_{12}H_{22}(C_2H_2O)O_{10}$. The author describes a series of results of experiments of various reactions of divers substances with this compound, but our space does not permit us to enter into details.

We only notice the titles of the two next papers, which are not suitable for abstraction:

Observations on the Phenomena of Supersaturation.—M. Margueritte.

Second Notice on the Theory of Supersaturation and Solution.—M. Lecocq de Boisbaudran.

Salts of Phenetolsulphuric Acid.—MM. Opt and Lippmann.—Phenetol—

$$\left.\begin{matrix}C_6H_5\\C_2H_5\end{matrix}\right\}O,$$

is a liquid, boiling at 168° C. When sulphuric acid is added to it, a pink colour ensues, and, after the mixture has been heated upon a water-bath for about an hour and a half, a crystalline mass is formed; this is dissolved in much water, treated with baryta water, and the excess thereof eliminated with carbonic acid. In this manner, a beautifully crystallising baryta salt of the phenetolsulphuric acid is obtained:

the composition of this salt, in 100 parts, is:—C, 35·62; H, 3·03; Ba, 25·04; H_2O, 11·78. The formula is—

$$C_6H_4So_3C_2H_3O)_2Ba'' + 4H_2O.$$

The authors briefly describe the lead and potassium salts of this acid.

Elimination of the Nitrogen contained in Beet-Roots during the Process of Manufacturing Sugar therefrom.—M. A. Renard.—This paper is chiefly of importance to beet-root sugar-makers.

On the Meteoric Stone fallen from the Sky, on the 22nd of May, 1869, at Cleguerec Departement du Morbihan, France.—M. Limur states that, on the evening of the 22nd of May last, at 9·45 p.m., local time, there was heard at Vannes, the capital town of the department, a heavy report, like that due to the firing of large ordnance, while the sky was at the same time illuminated by a bluish white light, accompanied by sparks somewhat like those of fireworks. The next day the author learned that, at Cleguerec, a meteoric stone had fallen, which had been broken into pieces by the peasantry, and fragments of which, weighing 22 and 16 kilos. had been secured by some parties, who, knowing the value scientific men attach to these extra-terrestrial visitors, will shortly send them to Paris for investigation.

Palladium and Hydrogen.—M. Fevre states that, according to his experiments, the hydrogen in palladium saturated therewith is present as a chemical compound, and not simply in the state of condensed gas. The author also states that the vapour of boiling mercury is as little a conductor of electricity as hydrogen is, and that, therefore, the non-conductibility of hydrogen for electricity cannot be regarded as an objection to its being a metal.

Cosmos, No. 23, June 5, 1869.

The only communication contained in this number suitable for translation to our pages is—

New Marking Ink for Linen.—M. Kuhr recommends the following preparation:—One part of hypophosphite of soda, and two parts of gum arabic, are dissolved in sixteen parts of distilled water. The tissue, linen, or cotton to be marked is thoroughly moistened with this liquid, and then left to dry. After having become well dried, the following liquid, composed of one part of nitrate of silver, and six parts of gum dissolved in six parts of distilled water, is used as marking ink, with a quill-pen. The mixtures here described are stated to yield an indelible and very deep black-coloured ink.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, June 14, 1869 (No. 24).

This periodical is entirely filled with the reports about the prizes and the distribution thereof. The greater part of the speaking at this meeting of the Académie devolved upon the eminent and eloquent speaker who honoured the Chemical Society with his excellent speech on the night of Thursday (June 17) at the Royal Institution in London, M. Dumas; and his eminent *confrère* as Sécretaire Perpetuel, M. Elie de Beaumont, read the eulogium on the late M. Puissant, an excellent geodosist and late member of the Académie. Among the prizes distributed we notice the Jecker prize, which has been granted to M. P. A. Favre for his researches on the heat set free by chemical combination; a sum of 2,000 francs (£80) has been granted to M. A. Gautier for his researches on hydrocyanic acid, the nitriles, and a new class of substances isomeric therewith.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 196, April, 1869.

Omitting the papers on subjects connected with mechanics and engineering, we meet with a report—

On the New Method of Purifying Oils invented by M. Michaud, of Honfleur; the report is from the hand of M. A. Chevalier. After having reviewed the different processes in use from the middle of last century, to render fatty oils, such as rape seed and colza oils, more suitable for use in lamps of a more complicated construction, the author of the report states that M. Michaud's process consists of a defecation of the raw oil by the simultaneous introduction therein of jets of air and thin streams of sulphuric acid, whereby those substances contained in the raw oil, which are injurious to its properties for use in moderator and carcel lamps are coagulated and brought to the surface of the oil as a scum, which can be easily removed; the oil is next washed with water, afterwards heated by steam to 100° C., and lastly filtered through cotton and a layer of clean and pulverised marble, at a temperature of 40° C., yielding an excellent material for use in lamps.

This number also contains a lengthy treatise—

On Electricity and its Application to the Construction of Electrical Apparatus for Medical Use.

And a lengthy treatise—

On the Cultivation of the Mushrooms known as Truffles.—To this paper are added analyses of twenty-four different kinds of soil taken from various parts of France, but it does not, after all, appear that there is distinct relation between any kind of soil and its capability of growing these dainties, which, as appears from this paper, were largely cultivated in France, for the use of the wealthy Romans, at the time Cicero and Horatius lived. Curiously enough, those parts of France—the native country *per excellentiam* of truffles—which produce good wine, do, as a rule, also produce these cryptogamics in excellent condition.

Annales du Génie Civil, No. 5, 1869.

This periodical contains the following short notices concerning matters of interest to our readers, in addition to its valuable papers relating to mechanical science:—

Artificial Ebony.—This material is prepared on the large scale in the following manner:—60 parts of charcoal, obtained from seaweeds, and previously treated with dilute sulphuric acid, and dried, are ground to powder, and mixed with 10 parts of liquid glue, 5 of gutta-percha, and 2½ of caoutchouc, care having been taken to mix the two latter substances with coal-tar oil, and thus to render them gelatinous; next 10 parts of coal tar, 5 of pulverised sulphur, 2 of pulverised alum, and 5 of powdered resin are added, and the mixture heated to 300° F. After having been cooled, a substance is obtained, which in every respect is equal to genuine ebony wood, but is far less expensive, and takes a finer polish.

Vulcanisation of Caoutchouc.—In a great many instances, especially when a superficial vulcanisation only is desired, bisulphide of carbon and chloride of sulphur only are applied. Since the bisulphide is very inflammable as well as very volatile, and is, beside this, injurious to the health of the workmen, it is desirable to desist from its application; instead of it, petroleum is now used, after having been submitted to a peculiar process of refining; it is for that purpose mixed with sulphuric acid, thoroughly stirred, and, after having been left quiet for some time, the supernatant oil is withdrawn by means of a syphon, and placed in distilling apparatus along with some caustic potassa, and submitted to distillation. The refined petroleum thus obtained is, however, a less good solvent for caoutchouc than the bisulphide of carbon, and hence the vulcanisation process may, by the use of petroleum, become less complete and less penetrating than by the use of the bisulphide of carbon.

Manufacture of Phosphor

to apply for this p[illegible] the [illegible] like a blast fur[illegible]

Through a kind of throat or mouth, which can be hermetically closed, coke and phosphate of lime, either apatite, coprolites, or any other, are introduced, along with a sufficient quantity of a suitable flux to liquefy the lime of the phosphate and the ashes contained in the coke. A blast-pipe, connected with a blowing engine, introduces a sufficient supply of air to keep the coke, after having been ignited, at a high temperature, while a tube, plunging into a tank, filled with cold water, is intended to carry off the vapors of phosphorus set free by the reducing action of the coke upon the phosphate; the slag is run off in a peculiar manner, somewhat akin to that in use with blast furnaces at iron works, but so as to prevent phosphorus escaping. According to a note by the editor of the paper at the head of this notice, the results obtained with this furnace are very satisfactory.

Les Mondes, June 3, 1869.

Newly-Invented Gunpowder.—A Bavarian chemist, named M. Hahn, has brought to Paris a proposal to sell his invention of a new kind of gunpowder, which, according to his statements, is so readily prepared, that one workman while engaged for ten hours a day, can mix 200,000 kilos (200 tons) of the materials the powder is to consist of, which are substances readily procurable in any country. This powder, on being ignited, gives off no smoke, and is neither affected by damp nor dryness, and can be safely stored anywhere. We refrain from quoting more about this subject, as we fear *le bon* Père Moigno has been taken in somewhat, as would appear from the statement that this powder, while floating on water, yet explodes in contact therewith, and is not after all affected by damp (*sic*).

Boiling of Sugar.—M. Woestyn.—The only noteworthy point in this rather practical paper, is the observation, made by the author, that, notwithstanding the use of the vacuum pan, by the application of steam of 1, 2, 3, 4, or 5 atmospheres over and above the atmospheric pressure, and corresponding to temperature of 100°, 122°, 134°, 143°, 152° C., an increase of colouration, averaging 2, 4, 8, 12, and 16, is obtained, while, at the same time, research with the *saccharimetre optique* proves analogous quantities of inverted sugar in the product previous to the boiling free therefrom.

Among the books of which receipt is acknowledged we notice an Italian monograph, by M. A. Raffaelle Drago, which bears the title—"*Resumé* of the Theory of the Rev. Father Angelo Secchi, S.J., on the relation existing between the Meteorological Phenomena and the Variations of Terrestrial Magnetism." This book is highly spoken of in the above-named periodical, which contains a lengthy paper, "On the Phosphorescence and Luminosity of Gases under Reduced Pressure," translated from the official Gazette of the Kingdom of Italy; this paper, however, does not contain anything on this subject which is not already known to our readers.

June 10, 1869.

The only communication we briefly notice from this number is:—

Localities of Rock Salt.—Dr. A. Boué.—The author says: The ten or twelve large sites of rock salt at present known belong, in a geological sense, to either secondary or tertiary formations; those of the Devonian and Silurian deposits appear to have been formed by the evaporation of their existing seas, by the action of the heat of the interior of the globe. The saline deposits and beds of gypsum of triassic period are neither due to evaporation nor sublimation, and appear to have been rather formed by saline waters, saturated solutions of salt, from springs, running into then existing seas, and causing such a supersaturation as to bring about a deposit of chlorides and sulphates. The saline springs, salt springs of the cretaceous period, may be the result of fresh water which has become saturated with salt while traversing *deeper lying beds* thereof, and being afterwards forced up by hydrostatic pressure. It may be said that a continuous diminution of sea-water has been taking, and is yet actually taking place, from the first existence of a sea on our globe, either by chemical action or by infiltration.

NOTICES OF BOOKS.

More Light. A Dream in Science. Wyman and Sons, Great Queen Street, Lincoln's Inn Fields.

In the so-called "scientific world" we find a large number of men who do not work. The reasons why they do not work are not always so obvious as one would imagine. Some, including among them many of our most influential and successful men, do not work simply because they find it unnecessary. Fluent, strong in voice and in nerve; ambitious, and, perhaps, just the least thing in the world intriguing, they find it far more easy to acquire a position in scientific societies by criticising the researches of others than by working themselves. It is men like these who so mercilessly cross-examine the laborious workers who venture to read their papers before scientific bodies. These cross-examinations are, moreover, often carried on in a semi-bantering tone, as if the student had taken a liberty in bringing his results before a body, some of whose most august members found work unnecessary. And how often, in all countries, do we find the mantles of the greatest workers placed on the shoulders of these very men.

On the other hand, a vast number of those we meet in scientific circles do not work, simply because they prefer to dream. As there are people (even in this our day) who buy works on witchcraft and alchemy, not as curiosities, to be laid on the shelf until wanted as illustrations of the history of a past age, but to read them with reverence and faith, so there are men who revel in any darkness that has a savour of mystery. They have an instinctive repugnance of those physical truths which can be demonstrated by an appeal to the balance; as we have said, they prefer to dream; but we must do them the justice to say they generally keep their dreams to themselves. The author of the pamphlet before us is a man of a different stamp; he publishes his dreams, charges one-and-sixpence for them, and fearful that his just rights and property in his dreams will be infringed, he carefully reserves the right of translating them. This is wrong. When a great prophet comes to give us "more light" (and we confess that we need it), he should rather encourage than repress those who would disseminate it.

But, to proceed—It was on a winter's evening, in December, 1866, that our author sat by the fire reading, to relax what he is pleased to term "his mind," which had been for several hours absorbed in "abstruse scientific speculations." The book that he read was George Henry Lewes's "Life of Goethe." As he read his last memorable words, "More light!" and pondered upon their depth of meaning, he fell asleep. What then happened he does not tell us; but a mysterious line of asterisks at once informs us that it was something very awful. Soon there appeared at his right hand a man, "beautiful of countenance." On his brow was a band, on which appeared, in sparkling gems, the name "Oriel," "Light of God;" and in his right hand he held a rod. Our author here pathetically tells us that he "trembled." This was but natural; he probably feared that Oriel was about to lay it on. Oriel, however (who, although a highly rectified spirit, appears to disagree with the stomach or brain of the eminently dyspeptic dreamer), bids him not be afraid, and, good-naturedly taking him by the hand, places him on a "Pinnacle of the Universe."

Oriel then tells him the destiny of the sun, and explains a few other astronomical phenomena, in language which shows distinctly that he has read Herschel's "Astronomy," and that his reading has been for edification. Our author (doubtless because Oriel has laid aside his rod) now not only ceases to "tremble," or to be "afraid," but even summons up courage enough to put a regular poser to Oriel in these

startling words—"What is matter?" Oriel, evidently at a nonplus for the moment, does exactly what we all do under similar circumstances, and, instead of answering the question, proposes another, namely, "What is mind?" If our author had been sharp, here was a capital opportunity for a repartee. He should have answered "It is *no matter*;" but, instead of this, he somewhat feebly gives the views of Newton and Bishop Berkeley. Afterwards, feeling that he is expected to quote some more modern philosopher, he states "matter to be nothing but force, thus depriving it of that grossness generally supposed to belong to it." This, he says, "was the opinion of Faraday, who could not prove it, but yet believed it not impossible."

Poor Oriel, feeling himself unable to oppose the views of Faraday without losing the confidence of our Dreamer, then states his own views to be the same. We would here most respectfully put the following difficulty which occurs to us, to Oriel. If you say that matter is force, we hope you will admit that force is matter; and, therefore, if, by out-flanking the question, in endeavouring to *take* grossness from matter, do you not at the same time *give* grossness to force? We do not insist upon this argument, because we feel, with Sir Roger de Coverley, "that much may be said on both sides."

Oriel then goes on to show our Dreamer (let us here confess that we had very nearly omitted the capital D) the "original element," and to prove that "this original element" is, "paradoxical as it may seem, *nothing*."

Up to this point we had travelled in all faith with our author; but when we find him gravely state that Oriel's next step was to make this "original element" (which he admits to be nothing) revolve on its axis, we gave it up. We do not wonder, then, that after a few more feats, which Robert Houdin might have studied with advantage, our author says, "Despair took hold of me; my brain began to whirl, my feet to slip from under me, when—oh! relief!—I awoke; and it was a dream." At this point, we made a great discovery. "More light" is an allegory. Oriel means spirit; as we said before, highly rectified spirit; and thus we see that, under the influence of too strong a dose of "Oriel," we may expect our brains to whirl, and our feet to slip from under us.

Pharmacopœæ Recentiores, Anglica, Gallica, Germaniæ, Helvetica, Russiæ, inter se collatæ. Scripsit, præfatus est et indicem triplicem adjecit, H. HAGER, Phil. Dr., Vratislaviæ. Günther, 1869.

THIS work will, undoubtedly, be appreciated by all really scientific medical men, as well as by pharmaceutists everywhere, and Dr. Hager deserves the greatest possible credit, and the sincere thanks of the profession for this publication. As the title indicates, he has compared, *inter se*, the pharmacopœias recently published in Great Britain, France, Germany (not to be confused with the Pharmacopœæ Borussica (Prussian), for the work here alluded to is in use in Central Germany, in dominions not as yet Prussianised) Switzerland, and, lastly, the immense Russian empire.

Throughout this work, the rule of most continental pharmacopœias, that weighing shall almost always be resorted to, instead of measuring, has been rigidly adhered to, and the measures of the British pharmacopœia have been reduced to weights as far as possible. The book is alphabetically arranged, and is, therefore, easy for reference.

Taking a couple of instances, almost at random, we observe, in the Russian codex only, a very excellent prescription for making magnesia sulphurosa (sulfis magnesiæ), a salt now used internally in this country. The French codex has syrupus chinini sulphurici (sirop de sulfate de quinine), a useful preparation to give to young children, if required.

There are added to the work (1st) very useful tabulated forms, taken from the Swiss and German codices, wherein are indicated the single doses of the more active preparations and compounds *above* which the substances named should not be dispensed, *unless* the medical man who prescribes *distinctly* requires higher doses to be given; (2nd) indices or reference in the French, English, and Latin languages.

The book is well printed, in clear type, by M. Günther, at Breslau.

Labels for Chemical Substances. In paper wrapper, price 6d. London: John J. Griffin and Sons, 22, Garrick Street, W.C.

IN a recent number, we noticed several editions of chemical labels. We have since received another book, containing 195 labels, admirably arranged by A. VERNON HARCOURT, M.A., F.R.S., Secretary to the Chemical Society, and H. G. MADAN. The nomenclature is similar to that adopted in "Fownes" and "Roscoe." The labels for solutions contain an indication of the strength of the solution, and an explanation of the expressions used is also given. We are told that a book on laboratory practice, by the same authors, will shortly be issued.

Spectrum Analysis: six lectures delivered, in 1868, before the Society of Apothecaries of London. By H. E. ROSCOE, B.A., F.R.S. Macmillan and Co., 1869.

Lessons in Elementary Chemistry; Inorganic and Organic. By H. E. ROSCOE. New Edition. Macmillan and Co., 1869.

FEW men are so competent as Professor Roscoe to discuss the various processes and results of spectrum analysis. He has worked much on the subject of light, sometimes alone, sometimes with the men who founded the mode of analysis under discussion: it will also be remembered that he was the first to introduce the subject in a practical form to the attention of scientific men in this country; and he has translated many important memoirs relating thereto into English during the last few years.

The work before us appears at a peculiarly opportune time, since the recent spectroscopic observations of the eclipse of 1868, and the brilliant results in stellar chemistry obtained yet more recently, have made this branch of science perhaps more prominent than any other, whether we look to the novelty and magnitude of its deductions, or to the fact that it enables us to exercise, not alone a cosmic analysis, but a system of analysis embracing the universe.

Starting with Newton's discovery of the composition of white light, Professor Roscoe passes to the consideration of the properties of sunlight, and of the various coloured rays composing white light. The key-note of the whole subject was struck by Newton, in 1675, in the demonstration that "lights which differ in colour, differ also in refrangibility;" he proved, at the same time, that light which has once passed through a prism cannot be further decomposed, and that the various coloured rays constituting white light, when brought together again after decomposition, form white light. The author next considers the various conditions of different portions of the spectrum, and gives illustrations of the fact that the calorific intensity of the spectrum attains a maximum near the red end of the spectrum, while the chemical intensity culminates near the violet end of the spectrum. An account of Fraunhofer's lines concludes the first lecture.

A noticeable feature of the work is the addition of an appendix to each lecture (often exceeding in length the lecture itself), in which extracts from the more important of the memoirs quoted are given, and the most recent discoveries—too late for insertion in the text of the lectures—are described. In the appendix to the first lecture, a lengthy extract is given from Newton's "Optics," regarding the *modus* of the original experiment on the decomposition of light. There are, also, some remarks on the application of magnesium wire as a source of light for photo-
poses, in the course of which it is

magnesium wire, of the thickness of 0·297 millimetre, evolves . . . as much light as seventy-four stearine candles of which five go to the pound."

The second lecture treats of the spectrum of incandescent solids and gases, and the method of producing and examining their spectra. In speaking of the delicacy of the method of spectrum analysis, it is stated that 180,000,000th part of a grain of sodium can be readily detected; 6,000,-000th of lithium, and 1,000,000th of strontium. Among the more important results produced by this branch of the subject, is the discovery that lithium, previously known to exist in but four minerals, is now found to be one of the most widely-distributed metals. An interesting account is appended to this lecture of Bunsen and Kirchhoff's mode of working with the spectroscope.

The third lecture contains an historical sketch of the rise and progress of spectrum analysis, and an account of the various new elements discovered by its means. We learn from this that, so far back as 1822, the spectra of many-coloured flames were examined by Sir J. Herschel. On page 96, elaborate analyses are given of the mineral waters in which cæsium and rubidium were first discovered. The lecture concludes with an account of, perhaps, the greatest application of spectrum analysis to the purposes of the manufactures which has yet been made, viz., its application to the process of making steel by the Bessemer process. In this operation, it is of the utmost importance that the operation of blowing air through the molten metal should be stopped the instant that the proper amount of carbon has been removed from the metal. "If the blast be continued for ten seconds after the proper point has been attained, or if it be discontinued ten seconds before that point is reached, the charge becomes either so viscid that it cannot be poured from the converter into the ladle from which it has to be transferred to the moulds, or it contains so much carbon as to crumble up, like cast-iron, under the hammer." The precise moment to stop is judged of by examining the flame as it issues from the mouth of the converter, by means of a spectroscope, and the moment that the carbon lines disappear from the field of view, the blast is shut off.

In the fourth lecture, Professor Roscoe discusses the spectra of metals volatilised in the electric arc, a subject which received much attention from Angström in 1855, he having mapped no less than 32 spectra, while Mr. Huggins has mapped 24. Thalén has recently investigated and mapped the lines of some of the rarer metals; among them, glucinum, thorinum, and zirconium. At page 156 will be found two very admirable maps of metallic lines, from the drawings of Mr. Huggins, and these are followed by extracts from the memoirs in which he describes them.

In the fifth lecture is commenced the important subject of solar and stellar chemistry, an account is given of the discovery of the coincidence of the dark solar lines with bright metallic lines, of Kirchhoff's explanation of the cause of the coincidences and the deduction therefrom of the well-known theory of the constitution of the sun. We find here two very beautiful reductions of Kirchhoff's maps of the solar spectrum, together with the map of Angström and Thalén, of the spectrum from G to H_2 drawn to the same scale. An experiment is described on page 191 in which "a constantly burning black soda flame" is produced by viewing a soda flame through a surrounding shell of soda flame; this is an admirable experiment for a large audience, provided they are not seated on gradually ascending seats, when of course many look down upon the inner soda flame without looking through the surrounding flame. The appendix to this lecture contains a detailed account of the spectroscopic observations of the solar eclipse of 1868.

The last lecture is devoted to the subject of stellar chemistry, and is accompanied by a beautifully coloured map of the spectra of various stars and nebulæ, among them Sirius, and the blue and orange stars of β Cygni. The spectra of Aldebaran and α Orionis drawn to scale are given on page 235; in these stars no less than seventy lines have been observed, and Dr. Miller and Mr. Huggins have detected nine elements in Aldebaran, which, strange to say, include bismuth (not found in the sun), tellurium, antimony, and mercury. Finally, the spectra of comets and nebulæ are discussed, and it is stated that Brorsen's small comet, which is now visible, has been found by Mr. Huggins to give lines dissimilar to those yielded by any substance known on earth. The final appendices contains very lengthy abstracts from the memoirs of Huggins and Miller on stellar spectra, Kirchhoff's elaborate tables of the coincidences of the bright lines in the spectra of the metals with the dark solar lines, and the work is terminated by a list of the principal memoirs on spectrum analysis, divided into three parts. (1) "Lectures or Memoirs Relating to the subject of Spectrum Analysis generally," eighteen in number; (2) Memoirs relating to the Application of Spectrum Analysis to Terrestrial Chemistry," ninety-four in number; (3) "Memoirs relating to the Application of Spectrum Analysis to Celestial Chemistry," seventy-five in number.

The great extent of the literature of the subject well indicates the rapid growth (mainly since 1861) of the science of spectrum analysis, and we have in the work before us a condensed account of everything of importance which has been done in connection with it from the pen of a man who has himself contributed no insignificant labours in this direction. As to the book itself, it is clearly and concisely written, and is in no place unnecessarily complex. The numerous illustrations, together with the maps and coloured plates, tend greatly to simplify the more abstruse matters, and we heartily recommend the book to the general as well as to the scientific reader.

We are glad to notice the issue of a new edition of Professor Roscoe's useful "Lessons in Elementary Chemistry," a work now generally used by the junior classes in those schools (happily on the increase) in which natural science is taught. The present edition contains no less than fifty-six pages more than the edition of 1866, together with a few additional woodcuts; the index is very complete and comprehensive, and the examination questions have proved of service to science masters: we feel assured that this work will continue to occupy the position which it has gained among our school books.

Observations on some of the Fundamental Principles and Existing Defects of National Education. By NEIL ARNOTT, M.D., F.R.S., &c. Longmans, 1869.

IN about 32 duodecimo pages, Dr. Arnott very clearly sketches the outline for a good and useful system of education. The little book opens with what is very aptly called a general map or table of human knowledge, showing the natural divisions. The first embraces the three Kingdoms of Nature; the second the four orders of changes or phenomena among things, the knowledge of which is called Science. The third division is divided into two sections; (*a*) the two arts by which man acquires and stores knowledge; (*b*) industrial arts, fruits of human invention.

This is a comprehensive scheme, but it certainly appears to be the right way. The subjects just enumerated are briefly but lucidly explained and discussed in the subsequent pages of the book, which is a very valuable shilling's worth.

Proceedings of the American Association for the Advancement of Science; Sixteenth meeting, held at Burlington, Vermont. Cambridge, U. S.: J. Lovering. 1868

IT will be new to some of our readers to hear that there exists an American Association for the Advancement of Science, corresponding to our British Association, and that the meeting which is chronicled in the work we are about to discuss is the sixteenth meeting of that association. The institution and support of such an association indicates a zeal for science among our American brethren which is surely a

good omen, and a healthy sign of the times. Nothing more conduces to the spread of a love for science, and to the diffusion of scientific knowledge, a tutored scientific taste, and a *modus* of scientific thought, and nothing more encourages original research, than the banding together of scientific men for the one purpose of furthering each his individual study and pursuit. And what greater proof of this can be needed than that which Europe furnished in the seventeenth century? The downfall of Aristotelianism, and the consequent spreading love for the "new philosophy," did not culminate in, but almost started with, the rise of numerous scientific societies—the Accademia del Cimento, the Royal Society, the Collegium Curiosum, and the Académie des Sciences, all appeared in less than half a century after the death of Bacon and Galileo. A period of great intellectual activity exists not without the blossoming and blooming of such institutions, and they react on the period, and induce in it a greater charge of intellectual vigour. In a country like America, mighty in great works, the effect of such an association, if well supported, ought to be immense. We say "mighty in great works," because the opening of the Pacific Railway is yet in our minds, and, if there had not been some hundreds of eighth wonders of the world since the hanging gardens of Babylon were, with her "Babylon magna, mater fornicationum et abominationum terræ," razed to the ground, and since the Rhodian Colossus was broken up and sold as old brass, we think that the Pacific Railway would be that eighth wonder. Perhaps the only work to be compared with it for extent and magnitude is that other among the ancient (and modern) wonders of the world, the Great Wall of China; let us, however, remember that the Suez Canal and the Mont Cenis Tunnel are approaching completion, and will soon have to be placed in the same category with the Pacific Railway. But we are plunging into a theme which, if extended, will bear us far from our present subject.

The subjects which engage the attention of the American Association for the Advancement of Science are thus divided: A. (1) Mathematics and Astronomy; (2) Acoustics; (3) Physics and Chemistry; (4) Physics of the Globe (or, as we usually say in this country, Meteorology). B. (1) Geology and Mineralogy; (2) Palæontology; (3) Zoology.

The Association possesses a President, Vice-Presidents, Standing Committees, and Local Committees; and it appoints special committees for the discussion of special subjects. Among the latter we notice "a Committee to report in relation to uniform standards in weights, measures, and coinage." The address of the President (Professor J. S. Newberry), although short, gives a fair *resumé* of the dominant subjects of the day, in regard to both the philosophy of matter and the philosophy of mind.

The first paper which calls for our notice is by C. S. Lyman, of New Haven (Conn.), "*On a New Form of Wave Apparatus.*" It is designed to illustrate waves whose "type is the ordinary ocean wave in deep water. The apparatus exhibits not only the wave profile, with its progressive motions, but also the motions taking place below the surface in the whole mass of liquid affected;" and it illustrates the wave theory established by Gerstner, Scott Russell, Rankine, and others. The apparatus could scarcely be described without the aid of a woodcut, but it somewhat resembles the wave apparatus invented some years ago by Wheatstone (?) We frequently wish that some apparatus of this description appeared upon the lecture table, especially in lectures on light and sound. The subject of plane polarised light is difficult enough, in all conscience; what, then, shall we say to circular and elliptic polarisation? Surely, some means of visualising these actions might, with advantage, replace the black-board, and the old story of the wire grating and the card, and the ray of light with its *two sides*, an expression nearly as appropriate, we always think, as that about the two sides of a round plum-pudding.

In a paper entitled "*Tellurium a Metal,*" Mr. L. Bradley adduces experiments and facts which compel him to regard tellurium as a metal. "It is true," he says, in conclusion, "that tellurium is not malleable, nor ductile, as are many of the metals; neither is bismuth nor antimony. Like the non-metallic substances, it unites with oxygen to form acid; so do antimony, arsenicum, gold, chromium, manganese, and many other metals. With hydrogen it unites to form a hydruret; so do potassium, arsenicum, and antimony. In short, it possesses the universally admitted distinguishing characteristics of metals, and nothing either in physical character or chemical behaviour which it does not hold in common with some other metals. I must, therefore, call it a metal."

We come now to a paper entitled "*Chemical Diagrams and Derivative Symbols, Illustrating the Prominent Characteristics of Chemical Elements.*" Here we are introduced to a species of diagram appertaining more to heraldry than to chemistry, albeit, there is a touch of alchemical mysticism introduced. They are, for the most part, a sort of half-bred between John Rudolf Glauber's three enigmatical designs and the illustrations to the article "Heraldry" in Chambers's old "Encyclopædia." What have we here? A black triangle; along the sides of which the words carbon, boron, and silicon appear, the whole surrounded by a shield. Here, again, is a shield, "simple," bearing a triangle, "proper," on a field, "argent." In the next diagram, the triangle has burst out eruptively, and is vomiting forth small jets of bromine, sulphur, tellurium, &c. The mysticism is obviously on the increase; is this a treatise *De Secretis* of the Middle Ages? At least, we recommend the author to peruse the "Pretiosa Margarita Novella." But what is this shield with a bar sinister? Have we illegitimate compounds in chemistry? If so, we rather imagine that pseudomorphs ought to be ranged under this head. A greater wonder yet remains: the author proposes to designate lithium, sodium, potassium, rubidium, and cæsium by a star with five points. He is, perhaps, unaware that the precise star which he has drawn is used in heraldry to designate a third son. Now, to say that a third son in heraldry, and five alkaline elements in chemistry, are symbolically the same, is palpably absurd. *Q. E. D.* And we are bound to confess that we must apply the same mode of argument to the whole of the paper. We would beg to suggest to the author the term "Heraldic Chemistry."

This paper is followed by another by the same author, on "*A New Chemical Nomenclature;*" and here his mystical longings crop up again with renewed vigour. The terms of the nomenclature are mystical, heathenish, barbarous—shall we add insensate? Without a doubt, they are closely related to the words wherewith, in former ages, many have tried and some have hoped to raise the devil. What shall we say to *kalamalt, nobamet, tanamet?* The "acid chromate of sesquioxide of chromium" rejoices in the name of *chreamyut.* The bromide of ammonium is *olanab*; sulphate of soda *natemasot* [happily, poor Glauber is dead], while chloride of sodium becomes *sodamad* (and we do not wonder at it, after such treatment). One more example, and we have done. "Bihydrochlorate of bibromoterchloronaphthaline" is to be called *rurulebod*, a term which must originally have been suggested by a Regius Professor of the language of the Feejee Islanders. The cardinal question yet remains. Whence comes this jargon? and what does it mean? We cannot tell, unless it is the production of that wonderful book-composing machine used by the Laputan philosopher, which took in letters and turned out completed books, in any language and on any subject; and we would venture to remind our author that hard by, was a philosopher, who proposed to build houses from the roof downward, beginning with the chimney-pots. In all seriousness, we say to the author of this paper, seek rather to discover new chemical facts than to generalise upon those already discovered; avoid mysticism, give up heraldry and bars sinister, and, above all, remember a very pertinent passage in the "De Augmentis Scientiarum" (and does not the title-page say "The American Association for the *Advancement of Science?*"), in which Bacon says well *circa non certæ magis experi-*

consonum videtur, utres ponatur doctrinarum intemperies. Prima est doctrina phantastica, secunda doctrina litigiosa, tertia doctrina fucata et mollis: vel sic; vanæ imaginationes, vanæ altercationes, vanæ affectationes."

It only remains for us to say that the work we have considered contains several admirable papers, and that we wish all success to the "American Association for the Advancement of Science."

CORRESPONDENCE.

Equivalence and Quantivalence.

To the Editor of the Chemical News.

Sir,—No better proof can be wanted of the truth of Professor Williamson's remarks, upon the conflicting views held by chemists on the theories of equivalence and quantivalence, than a comparison of the opinions which those remarks have called forth.

Mr. Ward regards atomicity and quantivalence, equivalent and atomic weight, as synonymous terms. Mr. Orme describes the equivalent of an element as a varying quantity, from which the atomic weight is deduced by theoretical considerations, and from which it differs, being, of course, constant. Mr. Attfield tells us that the term equivalent is correctly used with "distinct meanings," that the equivalents of Cl, O. N, C, are 1, 2, 3, 4, "in regard to the exchangeable values of atoms," but $35\frac{1}{2}$, 8, $4\frac{2}{3}$, 3, "in displacing one part by weight of hydrogen." "Chemicus" seems to follow Wurtz in considering the term equivalence a substitute for atomicity.

Doubtless these conflicting ideas would be reconciled, and much vagueness overcome, by accepting the definitions given by Mr. Ward, but unfortunately for our peace of mind, we cannot adopt them, unless we shut our eyes to chemical phenomena and our minds to the reasoning of not less able chemists. Equivalence may justly be considered *ponderal*, but equivalent weight can scarcely be taken as synonymous with atomic weight, as Mr. Ward seems to think. Let it be for a moment considered that atoms represent forces—as may be done upon the supposition that saturated compounds are in a state of equilibrium—then we may suppose that the atom of phosphorus in such a compound as the pentachloride (PCl_5) exerts a force five times as great as one atom of chlorine, consequently $\frac{35.5}{5}$ will represent a force equal to that exerted by 35·5 parts by weight of chlorine, and may reasonably be said to be equivalent to it. No such equivalent relation, however, exists between 1 part by weight of hydrogen and 16 of oxygen.

The numerical nature of equivalence or atomicity is, of course, universally granted; a difference has, however, already arisen with regard to the use of these two terms, which Mr. Ward considers as synonymous. Naquet, in his excellent "Handbook of Chemistry," has preferred using the term atomicity for the maximum amount of saturation of which an element is capable, while he reserves the term quantivalence to express its varying saturating power. Thus he speaks of lead as being tetratomic, but forming a series of compounds in which it is bivalent. If atoms represent forces, they must be definite forces, which sometimes become latent, and it seems desirable to have a special nomenclature by which the degree of latency may be expressed.

Since, then, the word atomicity is objected to by chemists (not, I think, without cause), and the expression quantivalence has a special significance, I would suggest that the term equivalent *number* be used to express the *fixed* saturating power of polyatomic bodies. If this course were adopted, we should speak of an element, such as phosphorus, as having for its

Atomic weight.....	31
Equivalent weight.....	$\frac{31}{5}$
Equivalent number.....	5

And as forming compounds, such as PCl_3, it which it is trivalent, and others, such as PCl_4, in which its quantivalence and equivalent number are the same.—I am, &c.,

C. H.

Mawson and Swan's Labels.

To the Editor of the Chemical News.

Sir,—A thorough revision of the new Book of Chemical Labels, published by Messrs. Mawson and Swan, of Newcastle, has led to the discovery of three obvious errors of the press, which, I trust, you will permit me to point out. In the labels for Barium and Calcium Chlorides, the modern formulæ are printed as $BaNO_3$ and $CaNO_3$ respectively, instead of $Ba(NO_3)_2$ and $Ca(NO_3)_2$, and in the table of combining weights, the old number for Silicon is erroneously given as 14 instead of 28. By a singular mischance, one of the incorrect labels has been taken as a specimen for the publishers' advertisements. The indicated errors, which may be easily corrected by the pen, do not appear in the copies of the work which are now being used. The fact that only three mistakes are discoverable in a long series of formulæ may, perhaps, be deemed satisfactory evidence of careful compilation by those who have published chemical works, but after the precautions taken to insure correctness and consistency, even these few errors suffice to disturb the equanimity of

The Editor of the Book of Labels.

London, June 16th, 1869.

Quantivalence.

To the Editor of the Chemical News.

Sir,—The only apparent objection to the word quantivalence as a substitute for the expression atomicity is that mentioned by "C. H.," namely, that Naquet uses the latter term to indicate the maximum, and the former the varying saturating power of an element. Such limitations, however, are entirely unnecessary, and have not received general acceptance. Surely we may attack or defend the notion of constant against varying atomicity, otherwise synonymously termed quantivalence, without inventing special words or engaging in the vain endeavour to give to existing words fresh meanings in violation of etymology. Besides, if the question is to turn on priority, quantivalence was, I believe, originally offered by Hofmann as the pure equivalent of atomicity.

So much for the name; now for the subject. As a teacher of chemistry to large classes of students, I have found the doctrine of quantivalence of immense value to learners. At first, following good leaders, I treated radicals as if possessing, but not always exerting, constant quantivalence; latterly the one or two prevailing values of the (chemical) atom of the common elementary or compound radicals have been pointed out, the hypothesis of the self-contained or "latent" affinities of an atom being suppressed. This is the position I intend occupying until more evidence is forthcoming.

Reverting to the word. We recently heard one learned lecturer utter the barbarism monovalent, giving the accent to the last syllable but one; another speak of the barbarism pentavalent, also accenting the penultimate. I believe we simply follow rule in emphasising the third syllable from the end in the case of each of the words u-niv'-a-lent, biv'-a-lent, triv'-a-lent, quad-riv'-a-lent, quin-quiv'-a-lent, sex-iv'-a-lent. This matter is worthy of reference inasmuch as, amongst other reasons, euphonious words are the most acceptable—quan-tiv'-a-lence has a better chance of employment than quan-ti-va'-lence. Taking for guidance the pronunciation accorded to the old word e-quiv'-a-lent, there need be no difficulty in this matter.—I am, &c.,

John Attfield, Ph.D.,
Professor of Practical Chemistry to the Pharmaceutical Society.

Artificial Manures:

A COMMON SENSE VIEW OF THE PRECIPITATED PHOSPHATE QUESTION.

To the Editor of the Chemical News.

Sir,—I have perused Mr. Hughes's paper with some interest, but more of astonishment. Is it or is it not the fact, that the greater part of the soluble phosphate of lime supplied to the soil in superphosphates is very speedily converted into precipitated or reduced phosphates, *i.e.*, insoluble in cold water? If it be a fact (and Mr. Hughes will hardly dispute it), why does he ask the manufacturer to make the farmer a present of some 3 to 6 per cent of valuable phosphates, for all intents and purposes of agriculture equal to soluble phosphates? Doubtless, Mr. Hughes is a very good chemist; but, in his zeal in combating the unfair use of oxalate of ammonia as a solvent for *reduced* soluble phosphates, he has rushed off to the other extreme. In his hot haste, and fresh from his "half-hours" of stewing coprolites, first with half their weight, and then with double their weight of oxalate, he rashly seeks to *rob* the manufacturer of his hardly-earned soluble phosphates! and, no doubt, the next farmers' club that sends a set of samples to Mr. Hughes for analysis will get them analysed on this principle. Nearly all superphosphates in good condition, from having lain long in the pile, contain more or less of this reduced soluble phosphate. Will Mr. Hughes or Dr. Voelcker contend that, because Mr. Chesshire has used a faulty process (if it be so), and, by boiling for half-an-hour, may have obtained more soluble phosphate from his samples than their respective bulks contained, that therefore the manufacturers are to be fined half-a-crown (or some such sum) per ton for every unit of soluble phosphate which has become reduced in the pile? This is a matter of very serious importance to manufacturers, and one which it behoves chemists, and especially so-called agricultural chemists, to settle.

May I venture to suggest that, if Mr. Hughes will abjure hot water in his examinations for soluble phosphates, he will get more correct results, and, if he had used a cold and very dilute solution of the oxalate, his experiments would then have been of more value. Again—for his own satisfaction, and by way of testing this matter—will Mr. Hughes perform an analysis of the clear solution obtained by pouring distilled water on to superphosphate on a filter; and then let him take another portion of this solution, and *reduce* the whole of the soluble phosphate by precipitating it with ammonia or lime-water. He will then have some precipitated phosphates on which to operate, and, if he will send you his results, I doubt not they will be of some practical value. He will then be able to say the minimum of oxalate of ammonia required to re-dissolve this phosphate, which he now wishes the manufacturer to give to the farmer for next to nothing.—I am, &c.

Fair Play.

London, June 14th, 1869.

NOTES ON LECTURE EXPERIMENTS.

Combustion of Sodium.—The metal sodium is stated not to take fire on cold water, but this is incorrect. A small piece of the metal will not do so, but a piece the size of a nut will frequently ignite; the flame may suddenly "pop" out, and it may as suddenly become ignited again. It is also addicted to the unpleasant habit of suddenly bursting into fragments, and throwing the fragments of metal in all directions. After the combustion of any considerable quantity of the sodium, it is curious to observe how the soda may be seen tinging with a yellow colour the non-luminous portion of any gas jet that may be burning.—G. N. M., Northampton, May 26, 1869.

LABORATORY NOTES.

Phosphorus Holder.

To the Editor of the Chemical News.

Sir,—A few inches of lead tube, ¼ in. bore, is contracted to an open cone, at one end. As much phosphorus as one may choose is put into the cone of the tube; the phosphorus is made to project slightly from the cone; the upper part of the tube is filled with water, and corked. Thus is had a phosphorus "crayon" perfectly safe in the hand for luminous writings, &c.

To put in the phosphorus, as much as may be required is melted in a conical glass, or test-tube, the cone of which is larger than that of the lead tube.

This is put standing in the melted phosphorus, which fills the cone and tube to its own outside level. When cold, there is a nice projecting crayon, from the form of the glass. Any phosphorus outside the lead tube may be melted off.

To renew the writing point, a test-tube, conical below, is fitted to the cone of the lead; the whole held in warm water for a minute, as much phosphorus flows out as forms a new point. E. Kernan.

Phosphuretted Hydrogen.

To the Editor of the Chemical News.

Sir,—The solution of caustic potash and phosphorus are put into anything like an evaporating basin. On the application of heat, the gas comes off, taking fire at various points of the liquid surface. The cup may be very small, even a watch glass will do.

The basin with its contents may be put aside until required to act again. Even when quite cold, odd bubbles of gas come off.

An objection to this method is that the "rings" do not show; the gas bubbles are too small, and burst before they can unite to form one large one strong enough to overcome the air currents. Could this be effected, the open basin would be a considerable improvement on the retort production of phosphuretted hydrogen. E. Kernan.

Laboratory Pump.

To the Editor of the Chemical News.

Sir,—I forward a description of a slight addition which I have devised to the valuable filter pump of Professor Bunsen, whereby the filtrate, if required, may be retained for further research.

Take an ordinary bell-glass receiver used in collecting gases, open and ground at the bottom, and closed at the neck with a stopper. Remove the stopper, and replace it by a cork, through which passes the funnel and exhausting tube, as shown in the flask in Professor Bunsen's arrangement. The receiver can then be placed on a glass plate, a beaker introduced within it, and the joint between the receiver and the plate made good with a little tallow. The funnel should be lengthened by fusing a piece of glass tube to it, so that it may reach half way down the beaker, as the liquid dropping from the funnel in the rarefied medium is very apt to splash upwards. John Dods.

Laboratory, Crewe Works,
L. and N.-W. Railway Co.

Blowpipe Reaction of Thallium.

To the Editor of the Chemical News.

Sir,—When either oxide of thallium is melted with borax, it gives a clear, colourless bead; but when this is kept for some time at a heat much below redness, the outside turns deep brown, owing to the formation of thallic oxide. On raising the temperature, it is again reduced to thallous oxide, small bubbles of oxygen are set free, and the bead again becomes colourless. I am not aware that any other substance

[illegible].

MISCELLANEOUS.

Collodion for Protecting Silver Ware.—The loss of silver which results from the impregnation of our atmosphere with sulphur compounds, especially where gas is burned, is very great. It has been said that many thousands of pounds' worth go down our sewers annually in the form of dirt from plate cleaning, and the loss of one large house on Cornhill from this source has been described to us as serious. Silversmiths may, then, thank one oft heir confraternity—Herr Strollberger, of Munich—for a happy thought. He seems to have tried various plans to save his silver, if possible. He covered his goods with a clear white varnish, but found that it soon turned yellow in the window, and spoilt the look of his wares. Then he tried water glass (solution of silicate of potash), but this did not answer. He tried some other solutions, to no purpose; but at last he hit upon the expedient of doing his goods over with a thin coating of collodion, which he finds to answer perfectly. No more loss of silver, and no longer incessant labour in keeping it clean. The plan he adopts is this: He first warms the articles to be coated, and then lays them carefully over with a thinnish collodion diluted with alcohol, using a wide, soft brush for the purpose. Generally, he says, it is not advisable to do them over more than once. Silver goods, he tells us, protected in this way, have been exposed in his window more than a year, and are as bright as ever, while others unprotected have become perfectly black in a few months.—*Mechanics' Magazine.*

A New Alloy (says *Iron Age*), forming, we are told, a beautiful white metal, very hard and capable of taking a brilliant polish, is obtained by melting together 70 parts of copper, 20 of nickel, 5½ of zinc, and 4½ of cadmium; it is, therefore, a kind of German silver, in which part of the zinc is replaced by cadmium. It is used largely in Paris for the manufacture of spoons and forks, which resemble articles of silver.

Amalgamation of Zinc for Galvanic Batteries.—In a somewhat lengthy, and not by any means very lucidly written, paper in *Les Mondes*, M. D'Almeida has described a series of experiments made by him with amalgamated zinc and other metals, and, moreover, with polished substances, such as glass, to prove that the cause of the very far less rapid solution and attack of zinc and other metals when placed in contact with acids, which, unless the said metals were amalgamated, would rapidly corrode and dissolve the same, is due, after amalgamation especially, to the physical change of the surface of the metal, and, as a consequence thereof, the adhesion to the metal of a thin layer of very minute bubbles of hydrogen gas retained to that surface by capillary action, and, as a consequence of their presence, the non-immediate and direct contact of the metal with the acid it is immersed in, but action of the latter upon the former through a layer of very minute bubbles of gas, which appears to be one of the causes of the slower corrosion of amalgamated zinc. The author has made a series of experiments, too long to be described in detail, which, certainly as far as the description goes, appear to prove his theory on this subject.

New Work by Dr. Odling.—Shortly will be published, in 1 vol., "Outlines of Chemistry; or Brief Notes of Chemical Facts," by William Odling, M.B., F.R.S., &c., Fellow of the College of Physicians, and Fullerian Professor of Chemistry at the Royal Institution. This volume will consist of the notes from which the author has lectured for the last six years at St. Bartholomew's Hospital, revised and somewhat extended, so as to furnish the student with a connected outline of the leading facts of chemistry in their relation to each other. It will be essentially descriptive in its character, and aim at calling to mind, in as few words as possible, the ascertained origins, properties, and metamorphoses of chemical substances. It will include a *systematic account of the monad*, diad, and triad non-metallic elements, and their principal combinations with each other; of silicon and carbon, with its series of methylic, formic, and cyanic compounds; and of the various metals, arranged, as far as practicable, in natural groups, with their respective series of halides, oxides, and oxisalts, &c.

Extraordinary Phenomenon.—The Caspian Sea or Lake is dotted with numerous islands which produce yearly a large quantity of naphtha, and it is no uncommon occurrence for fires to break out in the works, and burn for many days before they can be extinguished. Early last month, owing to some subterraneous disturbances, enormous quantities of naphtha were projected from the wells and spread over the entire surface of the water, and, becoming ignited, notwithstanding every precaution, converted the sea into the semblance of a gigantic flaming punch-bowl, many thousands of square miles in extent. The fire burnt itself out in about forty-eight hours, leaving the surface of the water strewed with the dead bodies of innumerable fishes. Herodotus mentions a tradition that the same phenomenon was once before observed by the tribes inhabiting the shores of the Caspian Sea, which exceeds in area that of England and Scotland together.

Essential Oil of Cochlearia officinalis.—It appears that this essential oil has been frequently confused with the essential oil of mustard, from which the author (Dr. A. W. Hofmann), on experiment, found it essentially different. The boiling point of the oil of *Cochlearia* is at about 160° C., that of the genuine oil of mustard at 147° C. On being treated with ammonia, the essential oil of *Cochlearia* yields a beautifully crystallising substance (the thiosinnamin of the essential oil of *Cochlearia*), which fuses at 135° C. Analyses of the oil and the ammonia compound just alluded to, prove the oil to be the mustard oil (*Senfol*), of the butyl series—

$$\left.\begin{matrix} C_4H_9NS = C_4H_9 \\ CS \end{matrix}\right\} N.$$

When butylamine (prepared from butyl alcohol by fermentation) is treated with sulphide of carbon and chloride of mercury, a mustard oil is obtained of the same composition and about the same boiling point, but the odour indicated that only an isomeric substance had been obtained, and further research proved that the ammonia compound of the oil, thus artificially produced, had its melting point at 90° C. The author intends to proceed with researches on this subject. — *Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

Memorial to Faraday.—A public meeting, at which H.R.H. the Prince of Wales will take the chair, will be held at the Royal Institution on Monday next, June 21st, at half-past 3, to consider the measures to be taken for the promotion of a memorial to Faraday.

Proposed New Physical Society.—It has been proposed to establish a Physical Society in London, and already many promises of support and proposals for membership have been received. We shall be glad to receive the views and opinions of our readers on this subject.

The British Association.—At a meeting of the council, on Saturday last (June 12th), Sir Roderick Murchison in the chair, it was reported by the General Secretary that the following Presidents of sections had consented to preside at the Exeter meeting. The following Vice-Presidents were nominated:—Section A (Mathematical and Physical Science). — President, Professor Sylvester, F.R.S.; Vice-Presidents, Professor Adams, F.R.S., and Mr. W. R. Grove, Q.C., F.R.S. Section B (Chemical Science).—President, Dr. Debus, F.R.S.; Vice-Presidents, Professor Odling, F.R.S., and Professor Williamson, F.R.S. Section C (Geology).—President, Professor Harkness, F.R.S.; Vice-Presidents, Mr. R. Godwin-Austen, F.R.S., and Mr. W. Pengelly, F.R.S. Section D (Biology).—President, Professor Rolleston, F.R.S.; Vice-Presidents, Mr. C. Spence Bate and Mr. E. B. Taylor.

Section E (Geography).—President, Sir Bartle Frere; Vice-Presidents, Sir George Grey, K.C.B., and Mr. A. G. Findlay, F.R.G.S. Section F (Economic Science and Statistics).—President, the Right Hon. Sir Stafford H. Northcote, M.P.; Vice-Presidents, Mr. T. D. Acland, M.P., and Colonel Sykes, M.P., F.R.S. Section G (Mechanical Science).—President, Mr. C. W. Siemens, F.R.S.; Vice-Presidents, Mr. G. P. Bidder, F.R.G.S., and Mr. C. Vignoles, F.R.S. The Mayor of Exeter, Sir Stafford Northcote, and Sir John Bowring were present, and supported the application of the working men for a special lecture during the meeting, which was unanimously agreed to, and subsequently Professor W. A. Miller, Vice-President and Treasurer of the Royal Society, was invited to undertake the duty.

Bleaching Soap.—This is a soda soap prepared according to the excellent prescription of the Prussian Pharmacopœia, which prescription has been copied in almost all other works of the kind; the soap is separated by common salt, and after this one-fourth of its weight of sulphite of soda is added, which has been previously made into a homogeneous paste by means of a little water; the soap is next dried in the usual manner. In order to apply this soap, chiefly intended for the bleaching of straw hats, but perfectly fit for application to silk and wool, it is dissolved in its own weight of cold water, and to every 2 lbs. of soap, ½ oz. of liquid ammonia is added. As soon as the mass has assumed a gelatinous aspect, 1 part thereof is dissolved in 8 parts of warm water. The materials which it is desired to bleach are washed and scrubbed by means of a brush in this soap-sud; while yet moist, the materials are placed in acidulated water (25 parts of water and 1½ of hydrochloric acid), left in this liquid for 2 hours, and then well washed, and rinsed with pure cold water, and dried. This soap is very largely and successfully used in Russia, and was first prepared in that country by Dr. Werner.—*Pharm. Zeitschr. f. Russl.*

Death of M. Berard.—We learn from the *Messager du Midi*, a daily paper published at Montpellier, that M. J. E. Berard died in that city on the 10th inst., at the advanced age of nearly 80 years. The deceased, a celebrated chemist, was born at Montpellier, on the 12th of October, 1789. He was first Professor of Chemistry of the Faculty of Sciences at Montpellier, and held simultaneously the Professorship of Chemistry of the Ecole de Pharmacie established in that city. For about the last twenty-five years he has been, first the active, afterwards honorary Dean of the celebrated Faculty of Medicine of the University of Montpellier—a post of honor and influence—and he has been well known in various scientific circles. He was a member of several learned societies, the owner of large chemical works, and a man of independent means—a very courteous, but yet somewhat haughty, scientific diplomatist; he was a staunch upholder of the rights of the Université de France, and, at the same time, in politics a constitutional liberal. Those who have been personally acquainted with him, like the writer of these few lines, can testify that he was an eloquent and highly accomplished lecturer, an eminently successful experimenter, kind and forbearing with the students of his class, who, on an average, numbered from 1,000 to 1,800.

London Institution.—We have received the report of the above institution, from which we find that it is proposed to adapt the chemical resources of the Institution to the practical teaching of chemistry. The following is an abstract of Professor Wanklyn's "Laboratory Report for the Session 1868-9":—In addition to the annexed list of papers [a list of eleven papers follows, abstracts of which have appeared in our columns] from the Laboratory, it should be mentioned that a very elaborate memoir on the alcohols of fermentation, by my friends Messrs. Chapman and Smith, has been laid before a recent meeting of the Chemical Society, and is in course of publication in the "Journal." Much of the recent investigation has consisted in an elaborate confirmation of M. Wurtz's results—a circumstance which is not unimportant, regard being had to the great improvements in method which have been introduced since the date of M. Wurtz's investigations of butylic alcohol. The recent discovery of isomeric forms of the alcohols, and the exceedingly interesting structural differences presented by these isomers, give additional value to a careful study of a natural alcohol, such as butylic alcohol. The Royal Society has testified its approval of investigations such as this by making a grant of £50 to Mr. Chapman for the prosecution of researches of this character. In the paper entitled "*Researches on the Ethers*," read at the meeting of the British Association in Norwich, there is recorded a work in contradiction of a very important set of results published by eminent English Chemists a few years ago. The result contradicted is, that an acetic acid had been produced in which part of the *radicular* hydrogen had been replaced by the metal sodium, so as to yield sod-acetic acid, or, more correctly, sod-acetic ether. It has been shown that, contrary to the assertion of two English chemists, there is no driving out of hydrogen by the action of sodium on acetic ether. As a consequence of the disproof of the elimination of hydrogen, a huge superstructure of unsound chemical theory has been destroyed. In conclusion, I would just call attention to the very interesting set of compounds—the salts of the new organo-metal, ethylene-sodium—which have been recently discovered in the laboratory of the institution, and which are being investigated at the present moment."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1277. J. Scharr, Stuttgard, Wurtemburg, "Improvements in the manufacture of liquid soap."—Petition recorded April 24, 1869.

1391. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in the treatment of cast-iron for the production of wrought-iron and steel therefrom."—A communication from W. M. Lyon, Pittsburg, Penn., U.S.A.—May 6, 1869.

1409. F. C. Knowles, Lovell Hill, Berks, "A new or improved method of purifying and converting cast-iron into malleable iron or into steel, and for the making and use of materials and appliances for the same."

1413. E. Maybury, G. Matthews, and E. Marston, Pendleton, Lancashire, "Improvements in puddling furnaces."—May 8, 1869.

1414. R. Cadbury and G. Cadbury, Birmingham, and J. M. Randall, Torquay, Devonshire, "A new or improved description of biscuit manufactured from the cacao bean."—Petition recorded May 8, 1869.

1418. H. R. Lumley, St. John's Wood, "The treatment of molten iron in order to free it from all impurities."

1419. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in desiccating and preserving meat and other organic substances."—A communication from C. Tellier, Passy, Paris.

1426. W. E. Newton, Chancery Lane, "An improved process and composition for hardening common or grey cast-iron, and for converting articles of iron into steel, or imparting thereto a steely character."—A communication from B. W. Nichols, Canton, Ohio, U.S.A.

1431. H. Bessemer, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in furnaces and apparatus employed for their fusion and treatment."

1432. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working furnaces and apparatus employed in fusing malleable or wrought-iron, and steel and pig, or other carburets of iron, and obtaining cast steel, or homogeneous malleable iron therefrom."

1433. H. Bessemer, Cannon Street, London, "Improvements in the conversion of fluid crude iron and molten pig, or other carburets of iron, into fluid homogeneous malleable iron and steel, whether such pig or other crude iron is used alone, or is mixed with a portion of malleable, or more or less decarburised iron, in a solid or fluid state."

1434. H. Bessemer, Cannon Street, London, "Improvements in the treatment of crude or pig-iron, and other carburets of iron, and in the apparatus employed for such purposes."—May 10, 1869.

1435. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working blast furnaces employed for smelting the ores of iron, and in the mode of employing and utilising the gaseous products of such furnaces, and also in the construction and mode of working blast engines employed to force air into blast and other furnaces."—May 10, 1869.

1440. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved detergent, or saponaceous compound."—A communication from W. H. Newton, New York, U.S.A.—May 11, 1869.

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1450. J. Robey, Newcastle-under-Lyme, "Improvements in sugar refining."

1458. P. W. Flower, Neath, Glamorganshire, H. Nash, Water Street, Liverpool, and R. Heathfield, Birmingham, "Improvements in coating sheets of metal with other metals."—May 12, 1869.

1464. E. V. Newton, Oxford Street, Middlesex, and P. M. Crane, Manchester, "A new or improved composition for coating ships, boats, and other surfaces, and for protecting and preventing the fouling thereof."

1469. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or treating oils and fats, and in apparatus therefor."—May 13, 1869.

1483. G. Felix, H. J. Axel, F. Bang, F. Roch, C. Monestier, and J. P. A. Fignier, Paris, "An improvement in liquids for the lubrication of sheep's or other wool, or other animal textile fibrous materials."

1486. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of beet-root and other pulps, and in the machinery or apparatus employed therein."—A communication from H. Champonnois, Paris.—May 14, 1869.

1493. L. A. V. Dubourg, M.D., Leicester Street, Leicester Square, Middlesex, "Improvements in the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein."

1495. W. Wilkinson, Seymour Street, Euston Square, Middlesex, and M. Bosa, Cleveland Street, Fitzroy Square, Middlesex, "Improvements in embossing, printing, enamelling, and ornamenting glass, metal, wood, canvas, or other woven prepared fabrics or other substances, and the preparation of the material, or materials and ingredients employed therein, and machinery or apparatus appertaining to a part thereof."—May 15, 1869.

1540. G. Martin, Dursley, Gloucestershire, "Improvements in the means of generating gases and chemical vapours employed in the manufacture of extract wool, and in destroying the vegetable material in mixed fabrics, and in the construction and arrangement of apparatus therefor, which apparatus is also applicable to other purposes."—May 19, 1869.

1562. J. McMillan, Dumbarton, N.B., and J. McGregor, Glasgow, N.B., "Improvements in the preservation of iron and steel, and structures composed thereof."

1568. G. Johnson, San Francisco, California, U.S.A., "Improvements in the distillation of spirituous liquors, and in apparatus to be employed therefor."—May 20, 1869.

1243. A. Borgnet, Swansea, Glamorganshire, "An improved composition to be employed as a paint."—Petition recorded April 22, 1869.

1539. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for obtaining gelatine and other products from animal substances."—A communication from D. K. Tuttle, O. Lugo, W. J. Hooper, and T. Hooper, Baltimore, Md., U.S.A.—May 19, 1869.

1575. C. W. Siemens, Great George Street, Westminster, Middlesex, "Improvements in calcining and smelting ores, and in furnaces and apparatus employed in connection therewith, which furnaces are also applicable to other purposes."—May 21, 1869.

1582. H. R. Lumley, St. John's Wood, London, "Improvements in treating and purifying crude iron, and in making steel, and in an apparatus for such purpose."—May 22, 1869.

1523. W. Benson, Hexham, Northumberland, "Improvements in treating or reducing ores, and in apparatus employed therein."—Petition recorded May 18, 1869.

1632. F. A. Barrow, Glasgow, N. B., "Improvements in purifying or bleaching mineral oils."—May 27, 1869.

1642. J. Brönner and H. Gulzkow, Frankfort-on-the-Maine, "An improved method of obtaining anthracen out of asphaltos—that is to say, pitch produced from coal tar—and of preparing two colouring matters from the anthracen."

1652. A. T. Fairgrieve, West Street, Sunderland, "An improved paste or composition adapted for coating the bottoms of wood and iron ships."—May 28, 1869.

1668. P. Kirk, Workington, Cumberland, "Improvements in puddling furnaces, and in other furnaces employed in the manufacture of iron and steel."—May 31, 1869.

1691. H. Browning, Salmon Lane, Limehouse, Middlesex, "Improvements in compositions suitable for use as varnish or paint."—June 1, 1869.

1700. G. V. Turnbull, C. Salvesen, and R. Irvine, Leith, N.B., "Improvements in the manufacture or preparation of lubricants or softeners, and the application of the same to the treatment of hemp, jute, flax, and other like fibrous materials."

1706. H. Larkin, Torriano Cottages, Leighton Road, and W. White, Thurlow Road, Hampstead, Middlesex, "Improvements in the manufacture of magnesium, and in the preparation of its anhydrous chloride."

1710. A. L. Simpson, Stowmarket, Suffolk, "Improvements in compositions suitable for treating sheep attacked by fly, and for other similar purposes."—June 2, 1869.

NOTICES TO PROCEED.

3959. G. T. Bousfield, Brixton, Surrey, "Improvements in extracting the colouring matter of madder root from the ligneous matter of the plant."—A communication from A. Paraf, New York, U.S.A.—Petition recorded December 29, 1868.

18. H. A. Bonneville, Chaussée d'Antin, Paris, "Certain improvements in the process of refining iron and making steel, and in the apparatus used in carrying out said process."—A communication from C. J. Cannon, Toulouse, France.—January 4, 1869.

42. K. Walter, Wicklow, "Improvements in the manufacture of sulphuric acid."—January 6, 1869.

62 *W. T. Waite, Salisbury Square, London, "Improvements in the treatment of saccharine matters."—January 8, 1869.*

98. *C. J. Günther, Mark Lane, London,* "Improvements in salting and preserving meat."—A communication from Baron J. von Liebig, Munich, Bavaria.—January 13, 1869.

230. A. V. Newton, Chancery Lane, "An improvement in fermenting substances and germinating grain and seeds."—A communication from R. d'Heureuse, San Francisco, California, U.S.A.—Jan. 25, 1869.

1278. T. Forster, Streatham, and P. B. Cow, jun., Streatham Common, "Improvements in compounds containing india-rubber, gutta-percha, or ballata, and in the manufacture of such compounds."—April 24, 1869.

106. C. P. Coles, Mountfield, Bonchurch, Isle of Wight, "Improved means of protecting the bottoms of ships, or other submerged structures, from fouling."—Petition recorded January 13, 1869.

130. P. Spence, Newton Heath, Manchester, "Improvements in the production of sulphate of potash for the manufacture of alum."—January 15, 1869.

148. F. Braby, Camberwell, Surrey, "Improvements in the commercial manufacture of sulphate of ammonia."—January 16, 1869.

186. H. A. Bonneville, Paris, "Improvements in the manufacture of illuminating gas, and of sponge, by the action of hydrocarbon liquids, or fluids, on metallic ores, and in the furnaces for melting said sponge and other metals."—A communication from C. J. Cannon, Toulouse, France.—Petition recorded January 20, 1869.

223. W. M. Welling, New York, U.S.A., "Improvements in compositions resembling ivory."—January 25, 1869.

246. C Gil, Boulevard des Capucines, Paris, "Improvements in the manufacture of sugar."—January 26, 1869.

252. T. Vaughan, Middlesborough-on-Tees, Yorkshire, and J. W. Smith, Manchester, "Improvements in treating smoke and soot for the preparation of an article of commerce therefrom."—January 27, 1869.

262. A. C. Pass, Bedminster, Bristol, "Improvements in the method of, and the apparatus for, condensing and purifying metallic and other fumes, vapours, gases, and smoke, and in obtaining oxide of zinc."—January 27, 1869.

287. F. Jay, South Lambeth Road, London, "Improvement in the manufacture of oil paint."—January 29, 1869.

330. C. D. Abel, Southampton Buildings, Chancery Lane, "The production of a new or improved hydraulic cement or artificial stone."—A communication from J. A. Dubus, Rue Aubert St. Denis, near Paris.—February 3, 1869.

355. F. Braby, Camberwell, Surrey, "Improvements in the treatment and utilisation of the waste solution of sulphate of iron, resulting from the cleansing of iron surfaces in the process of galvanising."—February 5, 1869.

376. E. Meldrum, Dechmont, Linlithgow, N.B., "Improvements in the manufacture of paraffin oil."—February 6, 1869.

753. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the preparation of artificial fuel, and in the manufacture of gas and coke therefrom."—A communication from J. M. J. C. Du Lin and J. A. C. d'Almas, Paris.—March 11, 1869.

1260. J. Major and W. Wright, Swallow Street, Middlesex, and G. H. Jones, Alpha Road, Middlesex, "A new or improved manufacture of white lead, and apparatus employed therein."—April 24, 1869.

1409. F. C. Knowles, Lovell Hill, Berks, "A new or improved method of purifying and converting cast-iron into malleable iron, or into steel, and for the making and use of materials and appliances for the same."—May 8, 1869.

1426. W. E. Newton, Chancery Lane, "An improved process and composition for hardening common or grey cast-iron, and for converting articles of iron into steel, or imparting thereto a steely character."—A communication from B. W. Nichols, Canton, Ohio, U.S.A.—May 10, 1869.

1431. H. Bessemer, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in furnaces and apparatus employed for their fusion and treatment."

1432. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working furnaces and apparatus employed in fusing malleable or wrought iron and steel, and pig or other carburets of iron, and obtaining cast steel, or homogeneous malleable iron therefrom."

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1434. H. Bessemer, Cannon Street, London, "Improvements in the treatment of crude, or pig-iron, and other carburets of iron, and in the apparatus employed for such purposes."

1435. H. Bessemer, Cannon Street, London "Improvements in the construction and mode of working blast furnaces employed for smelting the ores of iron, and in the mode of employing and utilising the gaseous products of such furnaces, and also in the construction and mode of working blast engines employed to force air into blast and other furnaces."—May 10, 1869.

1582. H. R. Lumley, St. John's Wood, London, "Improvements in heating and purifying crude iron, and in making steel, and in an apparatus for such purpose."—May 22, 1869.

318. W. J. Palmer and W. P. Goulding, Reading, Berkshire, "Improvements in evaporating and calcining alkaline solutions which have been used to boil vegetable fibres."—Petition recorded February 2, 1869.

362. J. Halford, Kingswinford, Staffordshire, "Improvements in puddling furnaces used in the manufacture of iron, and in other reverberatory furnaces."—February 5, 1869.

419. P. Taysen, Leith, "Improvements in the manufacture of stearic and oleic acids."—A communication from J. C. A. Beck, Copenhagen, Denmark.—February 10, 1869.

460. A. H. Lewis, Fenwick Street, Liverpool, "Improvements in extracting copper from its ores."—A communication from T. S. Hunt, Montreal, and J. Douglas, jr., Quebec, Canada.—February 15, 1869.

510. E. Dorsett, London Street, London, "Improvements in means and apparatus for heating, smelting, and working metals, and in furnaces employed therein, which improvements are also applicable to heating and otherwise operating upon minerals and other substances."—February 19, 1869.

699. J. P. Budd, Ystalyfera, near Swansea, Glamorganshire. "Improvements in the manufacture of iron and steel."—March 8, 1869.

727. G. Spencer, Cannon Street, London, and J. Barker, St. Leonards, Mortlake, Surrey, "Improvements in preserving animal substance, fruits and other substances, made from corn, grain, or other vegetable matter."—March 9, 1869.

1044. W. T. Rickard, Crown Court, Threadneedle Street, London, "Improvements in the preparation of cements."—April 7, 1869.

1418. H. E. Lumley, St. John's Wood, London. "The treatment of molten iron in order to free it from all impurities."—May 10, 1869.

1568. G. Johnston, San Francisco, California, U.S.A., "Improvements in the distillation of spirituous liquors, and in apparatus to be employed therefor."—May 20, 1869.

NOTES AND QUERIES.

Benzoic and Succinic Acids.—The commercial use of both these acids is very limited. Benzoin *resin* is used in perfumery, varnish making, and dyeing; in this latter operation both benzoic and succinic acids are also used and applied to a limited extent as mordants; beside this, both these acids are used in pharmacy, and, as is well known, applied in analytical chemistry, as ammonia salts chiefly; their high price would prevent their very extended use.

Mineralised Manure.—It appears from a short notice in *Les Mondes* chiefly intended *pour prendre date*, that there has been found, in the Department of the Haute-Saône, near Lure, a layer of from 40 to 100 metres thickness of a mineral made up of from 3 to 4 per cent of bituminous oil, 2·3 of nitrate of ammonia, 5·8 of nitrate of potassa, 40 of carbonate of lime, 25 of gelatinous silica, 0·5 of oxide of iron, and 0·1 of sulphur. This mineral deposit appears to be the result of the slow decomposition of vegetable and animal matter, especially molluscs, belonging to a former period of animal life on our globe.

Water Saturated with Gypsum.—The result of the analysis, by Dr. F. Goppelsroeder, of a spring water found on the Dürrenberg Estate, near Langenbruck in Silesia, gave for the saline matter found in 1000 c.c. of water:—1·636 grms of anhydrous sulphate of lime, 0·185 of sulphate of magnesia, 0·019 of carbonate of lime, 0·024 of carbonate of magnesia, 0·008 of carbonate of protoxide of iron, 0·005 of silica, 0·06 of chlorine (combined with alkalies); moreover, small quantities of alumina, baryta, strontia, ammonia, phosphoric acid, nitric acid and organic matter, which were not quantitatively determined. The solid residue of 1 litre of water, dried at 100° C., amounted to 2·503 grms.

Natural Water Containing Excess of Oxygen.—At Neubourg, Département de l'Eure, France, a spring of mineral water is found, from which a gas is constantly bubbling up and given off in large quantity, which, on analysis, proved to contain 44·6 per cent of oxygen, and 55·4 per cent of nitrogen; the gas causes, just as pure oxygen does, partly extinguished but yet glowing splints of wood to burst into flame. The analysis of the water proved it to contain in 4 litres the following quantities of saline constituents, expressed in gramme weight:

	grm.
Chloride of potassium	0·0096
Phosphate of lime	0·0128
Alumina and peroxide of iron	0·0200
Silica	0·0140
Sulphate of lime	0·0348
Chloride of magnesium	0·0688
Nitrate of magnesia	0·0878
Carbonate of lime	0·7210
	0·9688
Free carbonic acid	0·3284

—*Annuaire Pharmaceutique for* 1868.

Aniline Black.—The best kind of this dye is called in France, *Noir d'Aniline Lucas;* in England it is known as Petersen's aniline black; it is made, by a process kept secret, by M. F. Petersen, at St. Denis, near Paris. It is met with in commerce as a very deep black-coloured fluid, which, for the purposes of calico-printing and dyeing, has only to be thickened with starch paste, imparted to the tissue, and oxidised, to produce the finest deep black velvety-looking dye ever obtained. Among the very large number of prescriptions for manufacturing aniline black we notice Coupier's method, which is the following:—A mixture is made of 175 parts of nitrobenzin, 175 of aniline, 200 of commercial hydrochloric acid, 16 of iron turnings, and 2 of finely divided copper; this mixture is heated for from 6 to 8 hours at from 160° to 200° C., in an inside-enamelled iron-ware distilling apparatus. The operation is finished when a small portion of the mixture, having been previously removed from the apparatus and cooled, can be drawn into a tough thread-like mass, when rapidly pulled between the fore-finger and thumb. The dye produced in this manner is soluble in acids, alcohol, and wood-spirit. When it is intended to apply this substance as a dye, it is dissolved in sulphuric acid, serving as a dye bath, after which the woven tissue, thread, or yarn, has to be bathed in a solution of either an alkali or hyposulphite of soda, in order to fully develop the black dye; without this precaution a black, verging upon violet or blue, is obtained.

Contraction of Caoutchouc by Heat.—It appears that M. Govi, at Turin, has repeated the well-known experiments of Joule and Thomson about the contraction which caoutchouc, after having been previously stretched out, undergoes when heat is applied. The author has found that this contraction only takes place within certain limits of temperature, and that, if a greater degree of heat be applied, the stretched-out caoutchouc, even though by no means exposed to a degree of heat which softens it to a pasty mass, expands and becomes rapidly longer. This substance which has, in some aspects, puzzled philosophers, especially as regards some of its physical properties, has been frequently considered to consist of a kind of solid foam, made up of a large number of small vesicles filled with gas. This theory has been proved to be a reality, since Payen and others have seen these vesicles under the microscope, while M. Grovi has succeeded in expelling a portion of the gas from the vesicles by softening the caoutchouc, by means of oil of turpentine, and withdrawing by means of the vacuum of the air-pump, the ordinary atmospheric pressure. This peculiar kind of constitution of the caoutchouc being admitted, it is easily seen that the vesicles, when that material is stretched, will lengthen in the direction of the stretching force, and contract—become more narrow—in the perpendicular direction to that force. When, under these conditions, the caoutchouc is heated, the gas within the vesicles, while expanding, will have a tendency to return to the spherical shape it possessed before being stretched, and this explains, therefore, the paradox of its becoming shorter while heated; in other words contracting instead of expanding by heat.—*Les Mondes.*

Rendering Walls Impervious to Damp.—I am at present erecting a new laboratory, and am anxious to get the walls, &c., as impervious as possible to damp. Can any of the readers of the CHEMICAL NEWS tell me what agent is the best to use for this purpose on brick, plaster, and cement? A wash of silicate of soda has been recommended, but I fear the effects of efflorescence afterwards. Would a mixture of silicate of soda with some other agent obviate this? I see several makers of soluble glass advertise in your columns: perhaps they might be induced to answer this question.—BUILDER.

Recovered Grease.—Could any of your readers tell me how to detect recovered grease in tallow?—C. W.

Picrates.—Can any of your correspondents tell me the simplest and cheapest way of making picrate of ammonia and other picrates?—T. E. D.

Scale of Temperatures.—Will any of your numerous correspondents kindly direct me to any good and dependable scale of temperatures at which glasses and metals fuse, comprising all usual silicates of potassa and soda, and such compound metals as have been noted, the object being to obtain a pyrometric gauge for temperatures between 900° and 2000° F.—ALFRED PAYNE.

Colour of Vermilion.—It is a fact well known to artists, that the splendidly bright colour of vermilion (cinnabar, sulphide of mercury) has a tendency, especially if it has been mixed with white-lead, to become blackish brown and very dark coloured in a comparatively short time. This tendency of the vermilion is altogether obviated if, previous to being mixed with oil, it is thoroughly and intimately mingled with about ⅛th of its weight of flowers of sulphur.

Action of Different Bodies on Sulphuretted Hydrogen.—M. Bottger remarks that oxide of thallium inflames this gas when coming into contact with it; so do pure peroxide of manganese, peroxide of lead, and peroxide of silver obtained galvanically. With binoxide of barium, chlorate of lead, and chlorate of silver, the gas becomes vigorously inflamed; fulminate of silver also inflames the gas, and the salt explodes. Iodide of nitrogen explodes in contact with this gas, which, under certain conditions, is inflamed by gun-cotton.

Picrates.—"T. E. D." is referred to either Watts's "Dictionary of Chemistry," the *Handwörterbuch der Reinen und Angewandten Chemie*, vol. vi., or any treatise on chemistry, wherein he will find the required information, too long for the space at our disposal in Notes and Queries.

Recovered Grease.—We do not quite understand the meaning; for, as long as grease is not saponified, or otherwise altered, or purposely adulterated, so as to become thereby unfit for use, it remains grease to all intents and purposes, and its physical and chemical properties remain then, of course, unaltered.

Scale of Temperatures.—The latest edition of Gehler's extensive *Physikalisches Lexicon;* also the works of Karmarsch, and Prechtl's *Technologische Encyclopedie*, contain what is desired by our correspondent, who will find these works either in the library of the British Museum, or that of the Commissioners of Patents.

Ineradicable Writing.—A French technical paper, specially devoted to the art and science of paper manufacture, states that any alterations or falsifications of writings in ordinary ink may be rendered impossible by passing the paper upon which it is intended to write through a solution of 1 milligram (0·01543 English grain) of gallic acid in as much pure distilled water as will fill to a moderate depth an ordinary soup-plate. After the paper thus prepared has become thoroughly dry, it may be used as ordinary paper for writing, but any attempt made to alter, falsify, or change anything written thereon, will be left perfectly visible, and may thus be readily detected.

New Sulpho-Salts.—Can any one explain the notation and formulæ of Schnaider's new sulpho-salts? If the new notation be intended, the nearest approach would be, in old terms,—

$$KS + Fe_2S_3 = \begin{cases} K & 19{\cdot}6 \\ Fe & 37{\cdot}6 \\ S & 42{\cdot}8 \\ & 100{\cdot}0 \end{cases}$$

Schneider.
24·59
35·19
40·22
100·00

But the Bismuth salt is much more discrepant.—CHEMICUS.

["Chemicus" is reminded that all formulæ and all cyphers are correctly reproduced from the original papers they are taken from; and that the authors, and not we, are responsible for the formulæ, &c., which we have no right to alter or change.—*Ed.* C. N.]

"*On Employment of Constant Factors in Calculation of Indirect Analysis.*"—The following appears to me to be a more simple and more easily recollected method for determinations by indirect analysis:—Presuming the salt is ascertained to be a mixture of the chlorides of potassium and sodium, and the amount of chlorine has been determined, calculate the weight of NaCl corresponding to the weight of chlorine found; then, since for every molecule of NaCl that is replaced by KCl there will be an increase of weight equal to 16 (*i.e.*, the difference between K and Na), the *difference* between the calculated weight of NaCl and the weight of the salt, being due to the extra weight of K over Na, will, if divided by 16, give the number of atoms of Na which are replaced by K in the mixture; and the number of atoms, multiplied by the atomic weight 39·2 will give the weight of potassium, which, together with the weight of chlorine, being deducted from weight of salt, will give the weight of sodium. A general formula may also readily be used for determination of any substance formed by three elements—

Let (a) be the combining equivalent of the heavier element;
Let (b) be the combining equivalent of the lighter element;
Let (c) be the combining equivalent for the determined element.

$$(a^m + b^n + c^{m+n})$$

will then be the formula for any such compound; let it be equal to (x) calculate—

$$(b^{m+n} + c^{m+n})\ ;$$

let it equal (y); then—

$$\frac{x-y}{a-b} \times a$$

will give the weight of (a) contained in the substance.—M. P.

Superphosphates.—Probably some of your chemical correspondents would tell me if, in superphosphates, a chemist can say whether it has been made from bone material or mineral phosphate, either wholly or mixed. I am in the way of selling and buying such, and buy according to the quantity of soluble and insoluble phosphates present. I wish to buy nothing but bone material. According to Dr. Anderson and other agricultural chemists, the phosphate in mineral is of much less value than in bone this last season; the phosphate in mineral was sold at 10d. per unit per ton, while that in bone-ash was 1s. 5d. per unit per ton. I buy at the rate given for phosphates in bone-ash. I have sent to a number of chemists for analysis samples of my manure, and get often very irregular results from the same lot; but in no case can I be informed whether the manure has been made from bone ash wholly, or only partly, and how much of the one and the other. Is this problem within the range of ordinary analysis? If not, what guarantee have farmers that they are not paying for an article they do not get?—A CONSTANT READER OF THE CHEMICAL NEWS.

Albumen.—It frequently happens that among the dried albumen met with in commerce a variety is met with which is soluble in water, but not coagulated by the application of heat. Dr. Monnier, at Lyons, has succeeded in preparing this modification, and has studied its properties. When white of eggs is slowly evaporated by exposure to the heat of the sun, or rapidly evaporated to dryness on a water bath, after having been previously exposed to strong daylight for a considerable length of time, a modification of albumen is obtained, non-coagulable by heat. A dilute aqueous solution of this non-coagulable albumen is not precipitated by addition of acetic, formic, or tartaric acid, but the addition of these acids (a few drops) restores its coagulability by heat. In order to restore to 0·20 grm. of this dry albumen dissolved in 10 c.c. of water its coagulability by heat, it was sufficient to add 5 milligrammes of solid crystalline acetic acid, dissolved in 0·5 c.c. of water. If as much ammonia was added as exactly suffices to neutralise the acid, the albumen thereby again lost its property of becoming coagulated by the application of heat.—*Deutsche Industrie Zeitung.*

Rendering Walls Impervious to Damp.—This is not a very simple question; well-built walls of proper construction ought not to be damp: the causes of dampness may be—(1) bad foundation in a wet or ill-drained soil too impervious for water, and the use of unsuitable building materials, *i.e.*, too porous bricks or natural stone; (2) walls may be damp because on being exposed to rain, and made of materials which greedily absorb and retain water, they slowly but surely allow it to evaporate where the heat is greatest, viz., on the inner side; (3) damp walls may be due to the infiltration of water from drains, as well as from improperly-constructed gutters along the roof, and rain-water pipes. Really sound building materials, well-seasoned stone and sound bricks, laid in a proper cement and upon a suitable foundation, concrete if necessary, and application of coal tar or even asphalt, will insure against defects of soil wherein foundation is laid, especially if care be taken about proper drainage pipes. As to covering, coating rather, walls inside with materials to resist damp there are various means at hand. Supposing due care to have been taken in building the wall, and good materials to have been used, it may be coated with a thin layer of good Portland cement, mixed with a little plaster of Paris, and, after this is thoroughly dry, it may be hardened, and rendered impervious to water by painting it with boiled linseed oil and red-lead mixed together. If it is required afterwards to have a kind of stucco laid on, it not being intended to paper the wall, such stucco may be made up—(1) of gypsum, plaster of Paris mixed with a thin glue solution, to which a small quantity of sulphate of zinc has been added, constituting, after drying, a hard surface, which can be rubbed smooth with pumice-stone; (2) or a paint is used made of 50 parts of fine white sand, similar to that used in glass-making, 50 parts of marl, 9 of massicot, litharge, and 9 of red-lead, mixed with 4½ quarts of boiled linseed oil. Water-glass, or silicates of soda or potassa, have *not been found to answer well: perhaps* Szerelmey's silicate zopissa *might answer the purpose.*

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS *give notice that in accordance with a suggestion of* MR. CROOKES, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* MR. CROOKES *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

*** We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the CHEMICAL NEWS, and consequent pressure on our space, we are often compelled to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

E. K.—The lecture will be shortly published in our pages. Our publisher will write to you about the volumes of the CHEMICAL NEWS. The acid liquid is probably deliquesced phosphoric acid. We cannot vouch for the statements made by advertisers unless we have personally inspected the goods.

Tyro.—Add ammonium sulphide to the solution; collect, wash, and dry the precipitate, and fuse with a mixture of nitre and carbonate of soda.

H. Kelsoe.—The Adulteration of Food Bill, passed some years ago, is practically inoperative.

X. Q.—Cadmium amalgam is not at all brittle, but is tough, and highly malleable.

Messrs. J. B. and Co.—A letter is waiting for you at our office.

G. N. M.—There is no good description of the battery published. The manufacturer will give you any information you require.

E. K.—The book is excellent; the price a guinea. Thanks for the notes.

Sulphate of Manganese.—No. 494, p. 252 (*Am. Repr., July*, 1869, *page* 51). A letter is waiting for our querist on this subject.

E. H.—Good medicinal carbolic acid will answer the purpose; add it to the water in which the linen is washed, in the proportion of a teaspoonful of the acid to half a gallon of water.

Messrs. Macniven and Cameron, 23, Blair Street, Edinburgh.—We have received the pens, and like them much. The "Waverley" is as pleasant to use as a quill, while the "Owl" answers well for small, fine writing. The "Pickwick" is also good.

B. B.—We did not speak of the original articles contained in the periodical quoted by you, but only to articles abstracted and translated from other periodicals. We find on page 308, a paper originally published in June last; several other abstracts are from papers as old as those published in October last year. We will assume your correction of 1868 for 1858 to be correct; but it must be remembered that we do not, unless in special cases, abstract or mention the abstracts from other foreign sources met with in the periodicals we quote. At page 323 is a paper published a year ago at the time the periodical you allude to was issued.

A. B. E.—Our correspondent will find in No. 488, April 9, 1869, p. 178 (*Am. Repr., June*, 1869, *pages* 318, 319), the information he asks for.

Communications have been received from A. Voelcker; E. Kernan; C. Higgins, B.A.; P. M. Muir; S. Dunn; J. Davis (with enclosure); J. Pride; R. R. Tatlock; W. A. Todd; E. C. C. Stanford; F. A. Abel, F.R.S. (with enclosure); F. Jennings; R. D. Grindley; Mawson and Swan; A. Baxter; J. Heywood; Longmans and Co.; Dr. Rohrig; J. Spiller; Dr. E. Fleischer (Dresden); J. Hughes; E. H. von Baumhauer; G. Pearson; H. Yeates; C. Tomlinson, F.R.S.; B. Quaritch; Dr. Adriani; The Royal Institution; E. P. H. Vaughan; A. Clarke; and S. W. Rich; E. H. von Baumhauer; Macniven and Cameron; Sir William Thompson, F.R.S.; T. Bloxam; E. Kernan; Johnson and Sons; E. Hayes; C. Collins; C. Tomlinson, F.R.S.; C. Williams; A. Payne; R. W. Roberts; H. Fletcher; J. Wallace; E. C. C. Stanford (with enclosure); Mawson and Swan; E. Weston; D. Swan, jun. (with enclosure); H. H. Watson; E. Jones; Dr. R. Angus Smith, F.R.S.; Young and Co.; J. Davis; J. J. Lundy; J. Gregory; J. Riley; W. A. Todd; J. Muspratt and Sons; Klugsbury and Co.; R. D. Grindley; A. Gow (with enclosure); H. Nicol; W. Smith; Evans, Lescher, and Evans; G. G. Walmsley; C. S. Romains; G. W. Bucklyn; Robbins, Lane, and Pinniger; G. W. Buckley; R. Laurie; B. Nightingale; A. S. Herschel; W. Blench; Ritchie and Sons; J. H. Richardson; W. Wotherspoon; A. Wuth; J. Wallace; M. Prentice (with enclosure); H. Bassett; Maclachlan and Stewart; H. Greenwood; J. C. Major; J. Thorn (with enclosure); E. G. Tosh; T. Morson and Son; W. & H. M. Goulding (with enclosure); P. Squire; S. R. Muspratt; A. N. Graham; W. Balley and Son; J. Cliff; J. Tilley; F. W. Whiffin; H. Cole, C.B.; R. Gregson; J. C. Brough; J. Barclay; J. Jones; Dr. Bedford; E. F. Teschemacher; and J. Denham Smith.

Books Received.—"Spectrum Analysis;" Six Lectures delivered in 1868 before the Society of Apothecaries of London, by Henry E. Roscoe, B.A., Ph.D., F.R.S. With appendices, coloured plates, and illustrations. London: Macmillan and Co. "Archives Néerlandaises des Sciences Exactes et Naturelles, Publiées par La Société Hollandaise des Sciences à Harlem, et Rédigées par E. H. von Baumhauer. La Haye: Martinus Nijhoff. Londres: Trubner and Co.; Williams and Norgate.

AMERICAN SUPPLEMENT.

New York, August, 1869.

A New System of Assay Weights.

The French system of weights, now very generally employed by analytical chemists in this country, leaves nothing to be desired, as far as convenience and simplicity are concerned, except in a few cases where the results of analysis are not reported in percentages. In assaying ores of the precious metals the percentages of gold and silver would entirely fail to convey a clear idea of the value of the ore. The results must be expressed either in troy ounces per ton, or in coin values. As an example, 50 grammes of a gold quartz yielded 0·00475 grammes of gold and 0·00092 grammes of silver; reduced to percentages we should have—

Gold . . . . 0·00950 per cent.
Silver . . . . 0·00185 " "

reduced to troy ounces we have—

Gold . . . . 2·77 ounces per ton of 2,000 lbs.
Silver . . . . 0·54 " " "

or, reduced to coin value, we have—

Gold . . . . $57·25 per ton of 2,000 lbs.
Silver . . . . 0·68 " "

The advantage of the second and third methods of reporting the results are at once apparent.

To obviate the labor and danger of mistake which attend the calculations involved, we made use of the following table:

1 milligramme of gold or silver obtained from

100	grms.	equals	0·2916	troy ounce in	2,000 lbs.
50	"	"	0·5833	" "	"
25	"	"	1·1666	" "	"
10	"	"	2·9165	" "	"
5	"	"	5·8330	" "	"
2	"	"	14·5825	" "	"

This enabled the assayer to convert his results into troy ounces per ton by a simple multiplication. To simplify this still further, however, we have devised a system similar to those employed by assayers in Germany. We have our *assay ton* for the ore, and our *assay ounce* for the precious metal.

Selecting the milligramme for our assay ounce, the assay ton must be as many milligrammes as there are troy ounces in 2,000 avoirdupois pounds.

$$\frac{2000 \text{ lbs.} \times 7000 \text{ grs.}}{480 \text{ grs.}} = 29{,}166\tfrac{2}{3} \text{ troy ounces in}$$

one ton of 2·000 lbs., 29·1666 grammes, is the assay ton. Every milligramme of gold or silver obtained from this quantity of ore is a troy ounce in 2,000 lbs.

When it is desirable to use a larger quantity of ore, as in assaying poor gold ores, two or four assay tons may be employed; the milligrammes of gold obtained must then be divided by two or four to represent the troy ounces in a ton. For crucible assays of silver ores we use one-third of an assay ton of ore, and multiply the milligrammes of silver by three to give the troy ounces per ton. For scorification assays of silver ores we use one-sixth, one-tenth, or one-twentieth of an assay ton, according to the character of the ore; multiplying the number of milligrammes obtained by six, ten, or twenty, according to the quantity used. Becker & Son now manufacture, at our suggestion, a set of assay weights on this system. The set includes weights of the following denominations:

4	assay tons,	or 116·6666	grm.
2	" "	58·3333	"
1	" "	29·1666	"
$\frac{1}{2}$	" "	9·7222	"
$\frac{1}{5}$	" "	4·8611	"
$\frac{1}{10}$	" "	2·9166	"
$\frac{1}{20}$	" "	1.4583	"

Also the gramme series, from 100 grammes to 0.010 grammes (10 milligrammes) for fluxes and ores of the baser metals. This set of weights is intended for weighing ores and fluxes, and Becker & Son now manufacture a beautiful little balance, called by them "ore-scales," to be used with them, far superior in accuracy, strength, and durability to anything else of the kind, and costing but a very moderate sum. These weights and balances, though designed for ores and fluxes, are sufficiently accurate for the metallic buttons obtained in many assays, as well as for most technical analyses. For gold and silver assays, however, specially the former, the assay balance and fine weights should be employed in weighing the resulting buttons or globules. This system of assay weights has now been in use at the School of Mines of Columbia College for three years, and we think it leaves nothing to be desired in this direction.

Dangerous Kerosene.

Four children were burned to death at Corydon, Ind. on the night of July 3d; the fire is attributed to the explosion of a lamp while the children were all asleep. July 13th, Nora Woolf, of New York, aged 14, was fatally burned by an explosion of kerosene, used for kindling a fire. July 14th, John Stein, of Yonkers, was shockingly burned by the explosion of a kerosene lamp. July 13th, a kerosene lamp expoded at 71 Bayard street, New York. Mrs. Ami Festlonel was burned to death in Baltimore by the explosion of a can of kerosene oil. Mr. Wellington, of Boston, was fearfully burned by the explosion of a lamp containing "lucine oil." The lamp was shattered into more than one hundred pieces. "Lucine oil" is *a light and dangerous naphtha*, one of the most explosive products of petroleum. The East Hampton Rubber Thread Works, and the Valley Pump Co.'s Works were destroyed by fire, July 12th, caused by an explosion of naphtha; loss $140,000. We shall continue to record these shocking casualties, caused by *dangerous kerosene*, till by the passage of suitable laws we are satisfied that the pub-

lic has been properly educated on the subject. *Good kerosene will not explode.*

New Springs at Saratoga and Ballston.

Two new springs have recently been discovered at Saratoga, which very much resemble the famous Congress, and which are situated very near it: the Crystal Spring, owned by Mr. C. R. Brown, proprietor of the Park Place Hotel, and Hathorn's Spring, owned by Mr. H. H. Hathorn, proprietor of the new Congress Hall. The Pavilion and United States springs have been recently retubed, and preparations are now being made to bottle the waters. In Ballston two more artesian wells have been bored; one known as the "Franklin," on a hill, fifty feet above the creek, is owned by Samuel Hides and John Mitchel, the other in the valley, not yet named, is owned by S. B. Conde and J. V. Denton. The waters of these wells very much resemble that of the Artesian Lithia Spring, an analysis of which was given in our last issue (*Am. Repr., page* 54). The waters of all these springs are now undergoing analysis, and we shall soon be able to place the results before our readers.

Petroleum Statistics.

According to the Titusville (Pa.) *Herald*, the production of petroleum in that region has diminished one hundred barrels per day during the past two months. This decrease is caused by the natural falling off in the product of the oil wells having been greater than the additional yield of new and resuscitated wells. The torpedoing of wells resulted less successfully than during the previous month, and very few of the new wells completed were of importance. The total production during the month of June was 301,936 barrels, of 43 gallons each; which is a daily average of 10,064 barrels.

Edward W. Root, who has for several years been in charge of one of the laboratories of the School of Mines of Columbia College, has been appointed Child's Professor of Agricultural Chemistry at Hamilton College.

A New Mineral.

Prof. George J. Brush and John M. Blake have discovered that the dull black crystals which occur in the iron mine at Munroe, in Orange county, N. Y., and which have passed for pyroline, are really a new variety of chrysolite, for which they propose the name hortonolite.

An analysis by Wm. G. Mixter gave—

Silica	33·59	= oxygen	17·91	
Ferrous oxide	44·37	"	9·85	
Manganous oxide	4·35	"	0·98	
Magnesia	16·68	"	6·67	17·56
Lime	trace			
Potash	0.39	"	0·06	
Loss by ignition.	0.26			
	99·64			

The July number of *Silliman's Journal* contains a paper on the subject.

Recent Chemical Patents.

Issued July 6, 1869.

92,176.—Method of obtaining Benzole and its Homologues from Coal-Gas. F. Engelhorn, A. Clemm, H. *Caro*, C. Clemm, Mannheim, Germany.

92,215.—Apparatus for Filtering Liquids under Pressure. T. R. Sinclaire, New York.

92,229.—Process of Treating Vegetable Substances to obtain Fibre. B. C. Tilghman, Philadelphia, Pa.

92,269.—Water-Proof Fabric for the manufacture of Hats and other articles. D. A. Connor, Milford, Conn.

92,292.—Composition for Staining Glass. H. V. Edmond, Norwich, Conn.

92,303.—Papier-Maché Compound. G. F. Gœtze, New York.

92,337.—Nickel-Lined Culinary Vessels. S. C. Moore, Boston, Mass.

92,345.—Mode of Hardening and Working "Ransome Concrete Stone." R. Norris, Jr., Baltimore, Md.

92,358.—Artificial Stone. A. Quesnot, Bloomington, Ill.

92,390.—Concrete Pavement. H. B. Steele, Winchester, Conn.

92,391.—Apparatus for Generating and Carburetting Gas for Lighting Railroad Cars. J. H. Steiner, St. Louis, Mo.

92,405.—Manufacture of Hydrate of Magnesia. Carl Wandel, Waldau, Germany, assignor to F. O. Matthiessen and W. A. Wiechers, New York.

92,406.—Manufacture of Granulated Sugar. Carl Wandel, Waldau, Germany, assignor to F. O. Matthiessen and W. A. Wiechers, New York.

Reissues.

11,608, reissue 3,531.—Manufacture of India Rubber. J. L. Carew, Norwich, Conn., assignee of C. Swan, executor of D. Hayward, deceased.

87,075, reissue 3,534.—Process of Repairing Crucibles. W. F. Sherman, Bucksport, Me.

75,656, reissue 3,540.—Manufacture of Crushed Sugar. C. Spreckels, San Francisco, Cal.

Issued July 13, 1869.

92,416.—Finishing and Dressing Sheep-Skins for Leather. R. Andrews, Milwaukee, Wis.

92,427.—Manufacture of Tobacco Paper. P. M. Consuegra and R. Antiguedad, New York.

92,452.—Process for Coating and Beautifying the Surface of Billiard-Balls, Knife-Handles, &c. J. W. Hyatt, Jr., Albany, N. Y.

92,455.—Apparatus for Concentrating Extracts of Bark and other Liquids. T. W. Johnson, New York.

92,465.—Apparatus for Depurating Liquids. W. Needham and J. Kite, Vauxhall, England.

92,477.—Still for Alcoholic Spirits. W. and G. W. Robson, Cincinnati, Ohio.

92,615.—Atmospheric Tanning Apparatus. J. E. Kauffelt, Shrewsbury, Pa.

92,633.—Apparatus for Ageing Spirits. E. L. Morse, St. Louis, Mo.

92,635.—Carburetter for Air and Gas. W. J. Nichols, Buffalo, N. Y.

92,640.—Process of Purifying Alcohol and other Spirits. C. C. Parsons, New York.

92,651.—German Erasive Soap. G. Sanger, Beloit, Wis.

92,652.—Chemical Olive Soap. G. Sanger, Beloit, Wis.

92,653.—Combined Scouring and Fulling Soap. G. Sanger, Beloit, Wis.

92,654.—Detersive Soap. G. Sanger, Beloit, Wis.

92,655.—"Fulling Soap." G. Sanger, Beloit, Wis.

92,656.—Process for Refining Tallow. G. Sanger, Beloit, Wis.

92,667.—Manufacture of Iron. D. Stewart, Kittanning, Pa.

92,683.—Manufacture of Glue from the Pith of Horns. J. Windward, East Cambridge, Mass.

92,685.—Apparatus for Rectifying and Flavoring Spirits. L. Wolff, Chicago, Ill.

92,687.—Steam Petroleum-Gas Generating Apparatus. R. M. Whipple and A. I. Ambler, Chicago, Ill.

Reissues.

15,838, reissue 3,546.—Apparatus for Generating Carbonic Acid. J. F. Boyntory, Syracuse, N. Y.

72,335, reissue 3,553.—Manufacture of Iron. D. Stewart, Kittanning, Pa.

Issued July 20, 1869.

92,736.—Process and Apparatus for Utilizing the Waste Coal of Mines. T. M. Mitchell, Philadelphia, Pa.

92,744.—Fer.ilizer from Seaweed. J. G. Nickerson, Boston, Mass.

92,751.—Treating and Revivifying Bone-Black. J. Rogers and L. Reid, Brooklyn, N. Y.

92,757.—Composition for Preventing the Fouling of Ships' Bottoms. R. Sim, Naples.

92,763.—Manufacture of Rubber Balls. J. H. Tuttle, East Hampton, Mass.

92,764.—Process of Treating Vulcanized Rubber, Thread Waste. J. H. Tuttle, East Hampton, Mass.

92,810.—Fertilizer. R. Fish, Washington, D. C.

92,816.—Manufacture of White Lead. J. M. Gattman, New York.

92,836.—Manufacture of Photographic Pictures. J. R. Johnson, London, Eng.

92,855.—Washing and Cleansing Fluid. F. F. N. Marais, New York.

92,875.—Composition of Matter to be used in the Process of Restoring Steel. B. W. Nichols, Canton, Ohio.

92,876.—Converting Articles of Cast Iron into Steel. B. W. Nichols, Canton, Ohio.

92,892.—Hydrogen, Generator and Carburetter. B. Sloper, St. Louis, Mo.

92,894.—Manufacture of Wrought Iron and Steel direct from the Ore. G. H. Smith, New York.

92,901.—Mashing Grain for Distillation. M. Thompson, St. Louis, Mo.

92,924.—Compound Oil for Coating Leather and Metals. W. K. Wyckoff, Ripon, Wis.

Issued July 27, 1869.

92,932.—Sugar-Boiling Apparatus. M. Bonnin and C. Escudier, New Iberia, La.

92,934.—Method of Preserving the Aromatic Principle of Hops. E. D. Brainard, Albany, N. Y.

92,937.—Medical Compound. T. J. Butcher, Wenona Station, Ill.

92,941.—Condenser for Stills. T. J. Dean, St. Louis, Mo.

92,943.—Machine for Generating and Carburetting Gas. C. F. Dunderdale, New York.

92,981.—Method of Extracting Iron and other Oxides from Clay, Porcelain-earth, &c. W. J. Lynd, Golden City, Colorado Ter.

92,993.—Composition for Curing Corns. G. Oakley, Quincy, Ill.

92,998.—Zincking Iron. J. H. Peake, Washington, D. C.

93,002.—Finishing Split Leather. J. Putnam, Danvers, Mass.

93,012.—Method of Manufacturing Vinegar. F. Schleifer, San Francisco, Cal.

93,018.—Composition for Pavements, Roofing, &c. H. Staples, Nashua, N. H.

93,044.—Compound for Destroying Insects. B. Best, Dayton, Ohio.

93,066.—Apparatus and Process for the Manufacture of Salt. T. A. Davis, Watertown, N. Y.

93,072.—Apparatus for Evaporating Ammoniacal and other Liquids. L. S. Fales, New York, N. Y.

93,075.—Manufacture from Bananas and Plantains. T. Fry, New Orleans, La.

93,086.—Composition Dental Plate. A. Hill, Norwalk, Conn.

93,099.—Apparatus for Making Bromine. H. Lerner, Pomeroy, Ohio.

93,102.—Compound for Rendering Fabrics Water-repellant. R. O. Lowrey, Salem, N. Y.

93,105.—Hydrocarbon Burner. E. P. McCarthy, San Francisco, Cal.

93,113.—Method of Exploding Nitro-Glycerine. G. M. Mowbray, Titusville, Pa.

93,127.—Process of Purifying and Refining Alcoholic Liquids. F. Schleifer, San Francisco, Cal.

92,131.—Preparation of Iron for Medical Purposes. John E. Siebel, Chicago, Ill.

93,143.—Liniment. W. H. Wallack, Corunna, Ind.

93,155.—Manufacture of Iron and Steel. J. J. Johnston, Alleghany City, Pa.

NEW PUBLICATIONS.

THE ADULTERATION OF LIQUORS; WITH A DESCRIPTION OF THE POISONS USED IN THEIR MANUFACTURE. By Rev. James B. Dunn. Prize Essay. National Temperance Society.

We have rarely seen so complete an assortment of misstatements and gross exaggerations in twenty-four pages. All the sins, real and imaginary, of the brewers, the vintners, the distillers, and the publicans, from the "time of Homer" down to date, are here charged upon the present generation. The absurd quackery of the "Ohio Inspector," and the strychnine joke of the French professor, appear here as grim truth to terrify the toper—who, by the way, will not believe a word Mr. Dunn has written, for he knows whiskey is not all oil of vitriol and strychnine, having drunk it for years without suffering from corrosion or opisthotonus. We should be sorry to believe that the good cause of temperance needed any such assistance as the author of the prize essay offers.

THE JOURNAL OF APPLIED CHEMISTRY.

This very inviting paper is published simultaneously at New York, Boston, and Philadelphia, by Dexter & Co. It is now in its fourth year, and is doing an excellent work in making chemical science more popular. Within a few months its character has been greatly improved by the addition to the editorial staff of Prof. C. A. Joy, who possesses the very desirable talent of being able to present the truths of science in the most enticing form, freed from all the forbidding technicalities. The columns of the Journal are also enriched by excellent articles from the pens of Dr. W. A. Wetherbee and Dr. Adolph Ott. It is rather a new thing in this country to have papers devoted to popularizing science edited by really scientific men.

REPORT ON COMMERCIAL FERTILIZERS, made by Prof. S. W. Johnson to the Sec. Conn. Board of Agriculture.

This paper contains careful analyses of several of the fertilizers supplied to Connecticut farmers, and also gives the prices which the farmer can afford to pay for each. Furnishing this kind of reliable, money-saving information to the farmers is not a new idea with Prof. Johnson, as he has for several years been able, by his published analyses, to practically exclude the spurious fertilizers from the State. Pulverized oyster-shells do not find a ready market at fancy prices where his reports circulate. It is surprising that every State in the Union does not employ a chemist to perform this duty for the public which Prof. Johnson has performed in Connecticut. The amount saved to the farmers would be enormous.

THE AMERICAN JOURNAL OF SCIENCE AND ARTS FOR JULY contains the following articles specially interesting to chemists: 1. Notice of the Life and Labors of Charles Grafton Page, the Electrician, for many years Examiner in the U. S. Patent Office. 2. On the Effect of Atmospheric Air, when mixed with Gas, in Reducing its Illuminating Power. By B. Silliman and Henry Wurtz. 3. A Qualitative Separation of Cobalt and Nickel. By F. W. Clarke. 4. Note on Wollongongite. By B. Silliman. 5. On the Estimation of Carbonic Acid. By S. W. Johnson.

Bunsen's Flame Reactions.—Translated by Prof. Chas. F. Himes, Ph.D. 8vo, pp. 30.

This is an excellent translation of the important article of Bunsen, in which a new system of Qualitative Analysis is developed; in which the flame of the Bunsen gas-burner is substituted for the blow-pipe. By means of a few simple reagents and utensils the most striking results are obtained, with extremely minute quantities of material. This is another of those extremely beautiful inventions of Bunsen, to whom the chemical world is already so much indebted.

The Determination of Carbonic Acid.

Prof. S W. Johnson presents in the July number of the *American Journal of Science* a description of the apparatus and process which he has devised for determining carbonic acid. The carbonic acid is determined by the loss of weight experienced by the apparatus on the expulsion of the acid from its compound. It is not easy, however, to completely remove the acid without at the same time losing some moisture. Prof. Johnson makes a radical improvement on the old process, by filling the charged apparatus with carbonic acid gas, then decomposing the substance to be analyzed, by causing the acid to flow upon it. As soon as the disengagement of gas ceases, the apparatus, still filled with carbonic acid gas, is weighed again. In this manner all aspiration is done away with, and the desiccating material has simply to dry the gas yielded by the substance under analysis. The results quoted are very accurate.

A Qualitative Separation of Cobalt and Nickel. By F. W. Clarke, S.B., of Cornell University (*Sill. Am. J. Sci.*).

Mr. Clarke finds that the different properties of the ferricyanides of cobalt and nickel afford an easy means of distinguishing between these metals. As is well known, ferricyanide of potassium precipitates cobalt and nickel from their solutions. The cobalt precipitate is of a deep reddish brown color, while the nickel compound is of a dirty yellowish brown. The ferricyanide of nickel dissolves with the greatest ease in ammonia or water, or in solution of cyanide of potassium; while the corresponding cobalt compound is absolutely insoluble in either. The previous presence of ammonia water or cyanide of potassium entirely prevents the precipitation of the cobalt by the ferricyanide.

Mr. Clarke applies his test as follows: To the slightly acid solution of the two metals he first adds an excess of chloride of ammonium. This causes the cobalt precipitate, which would otherwise run through the filter, to fall in a denser state. He then adds the ferricyanide of potassium till the precipitation is complete, and afterwards agitates with a considerable excess of ammonia. The cobalt is completely precipitated, while the nickel may be separated from the filtrate by sulphide of ammonium.

BREVITIES.

Mr. E. Seymour has established a mineral agency at No. 52 Beekman street, New York, where mineral collectors will find a tolerably complete assortment of specimens at reasonable prices.

Dr. James P. Kimball, the geologist, has recently returned from Mexico, where he has spent considerable time examining the silver mines of Chihuahua. He gives the most astonishing accounts of the quantities of silver which have been already taken out of the mines by the Spaniards and Mexicans. As modern machinery has not yet been introduced, the mines have not been carried to any great depth, the workings having been confined to the zone above the water, without even penetrating the sulphurets. So there is every reason for supposing that untold quantities of silver await the skilful miners who shall introduce good pumps and systematic mining.

Prof. Raphael Pumpelly, of the Harvard Mining School, is travelling with his students among the copper and iron mines of Lake Superior.

Out of Twenty-one specimens of Kerosene Oil inspected by the New Haven, Conn., Fire-Marshal, only five were found to be up to the standard fixed by law.

Poisoning by Cyanide of Potassium.—Mr. Frederich Wettergreen, of 219 Fifth street, who died at his boarding house under suspicious circumstances, was found to have been p isoned by cyanide of potassium. The contents of the stomach were submitted to analysis in the editor's laboratory.

Impure Water.—A boy was poisoned at Farmington, Me., by drinking water from a well which, in consequence of its foulness, was not used by the family. Typhoid fevers and other very serious diseases often result from the infiltration of very small quantities of sewerage into wells. The cholera is often communicated at considerable distances by this means; whole families, and even neighborhoods, are sometimes afflicted with diseases which are ultimately traced to foul water.

Mr. Bayard Taylor has accepted a non-resident professorship in Cornell University, and will begin next spring the delivery of a series of lectures.

Prof. J. D. Whitney, the State Geologist of California, and Professor of Geology at the Harvard Mining School, is travelling in the West with a party of students.

Naphtha for Kerosene.—A man in Boston has been prosecuted for violating a law made by the last legislature, which provides that "no person shall sell naphtha under any assumed name, under penalty of one hundred dollars fine, and one month's imprisonment, either or both."

The men who sell the "American Liquid Safety Gas" would fare hard in the Bay State, as this is simply a highly explosive naphtha.

Prof. George F. Barker, of the Yale Medical School, is going to Europe to spend a year or two.

Thomas M. Drown, M.D., has been appointed instructor in Metallurgy, and William H. Pettee, instructor in Mining, in the School of Mining and Practical Geology at Harvard University.

Messrs. Schultz and Warker have erected a beautiful kiosk of Moorish architecture, handsomely decorated, in the Central Park, between the lake and the green, where their various mineral waters are supplied to visitors. The waters are all drawn from glass reservoirs through silver or block-tin tubes, so no one runs any risk of lead poisoning in drinking them.

Hippophagy.—During the second quarter of the present year the city of Paris has consumed 605 horses, or about 276,000 pounds net of horseflesh for the three months. A few mules and donkeys are included in the quantity, but the exact number is not specified.

The Presidency of the College of New York, made vacant by the retirement of Professor Horace Webster, has been accepted by Gen. Alexander S. Webb, a son of Gen. James Watson Webb. He graduated from West Point in the class of 1855, with the commission of brevet second lieutenant of the Fourth Artillery.

The Refrigerating Meat Expedition.—The steamship *William Taber* sailed from this port on Saturday for Galveston, purposing to bring back to the New York market a cargo of fresh beef slaughtered in Texas, and preserved throughout the voyage in the hold of the vessel by the refrigerating process. It is expected that the trip will require from thirty to forty-five days, dependent on consequences hereafter to be determined.—*New York Herald, July 27.*

Earth Closets.—The War Department has under consideration the proposed use of a system of earth closets at barracks and other military establishments. The matter is now undergoing an examination in the Bureau of Engineers, and the probability is that it will meet with a favorable report.

Professor Charles A. Aiken, of Princeton College, has been elected President of Union College at Schenectady.

Brandy from Lichens.—Experiments lately made in Sweden on a large scale, upon the production of brandy from lichens, and especially from the reindeer moss, have, it is said, proved so successful as to warrant the practical application of the process.

A New Locality of Franklinite; by W. A. Fonda.—A vein of franklinite has been opened at Centreville, five miles above Paterson, on the side of "Second Mountain." The ore has the same general characteristics with that obtained from Stirling Hill and Franklin Furnace mines. The gauque is rhodonite, and calc-spar in some specimens.—*Sill. Am. J. Sci.*

Prof. E. W. Root has discovered acicular crystals of millerite, sulphuret of nickel, in cavities with spathic iron crystals, in the gneiss of New York Island, at the corner of Fifty-seventh street and Broadway. This rare mineral occurs here in exactly the same form, of acicular tufts, as at Antwerp, Jefferson Co., N. Y.

Alcohol from Garbage.—A company has been formed in Chicago, and will be soon in operation, for distilling alcohol and extracting soap grease from ordinary city garbage. The process is a patented one, and consists in taking the garbage just as it is hauled off in the city carts, dumping it into tight tanks, and boiling six hours at a temperature of 212 degrees. This dissolves the whole mass, which is run into fermenting tubs and worked with yeast. The soap grease and impurities rise to the top of the tubs, and are skimmed off, and the residuum is distilled in the regular way. It is estimated that each barrel of garbage will yield three pounds of soap grease and four gallons of proof spirits. The soap grease is, of course, as good as any other, but the alcohol betrays its origin by an odor which requires further processes for its removal. For many uses, however, it is as good as that derived from grain or molasses, and, if its distillation is not too costly, will yield a considerable profit.—*Sun, July 22, 1869.*

The New Paper for Government Securities.—Secretary Boutwell has notified the public that by authority of law he has adopted a distinctive paper, which will hereafter be used until otherwise ordered, for all obligations and other securities of the United States. One of its peculiarities is the introduction of colored silk, cotton, and other fibrous materials into the body of the paper while in the process of manufacture. By the law of the United States it is made a felony, subjecting the convicted offender to a maximum fine of five thousand dollars, or a maximum imprisonment, with hard labor, for fifteen years, or both, at the discretion of the court, for any person to have or retain in his possession or custody any paper adapted to the making of such obligations or securities, and similar to that designated by the Secretary of the Treasury or some other proper officer of the United States. The new national currency has done much to reduce counterfeiting, and it is to be hoped that the effect of Mr. Boutwell's new order will be to abolish it altogether.—*Herald, July 23, 1869.*

THE CHEMICAL NEWS.
Vol. V. No. 3. American Reprint.

THE FARADAY LECTURE,

DELIVERED BY

M. J. DUMAS,

Sénateur; Président de la Commission des Monnaies et Médailles; Member, and one of the Perpetual Secretaries, of the Institute; Inspecteur Général de l'Enseignement Supérieur; Président de la Société d'Encouragement pour l'Industrie Nationale; Grand Croix de la Légion d'Honneur, &c., &c.

BEFORE THE

CHEMICAL SOCIETY OF LONDON,

IN THE

THEATRE OF THE ROYAL INSTITUTION,

THURSDAY, JUNE 17TH, 1869.

GENTLEMEN,—You have desired that the memory of Faraday should be handed down to posterity; you have summoned together men of science, all to celebrate in a solemn manner, his great and beneficial labours; and, calling upon France to take the lead in this solemnity, you have chosen me to be his panegyrist, no doubt on account of the long and constant friendship with which I was honoured by Faraday.

I am the bearer of the acknowledgments of the scientific men of France, as well as my own. My country—I am proud to say it—can offer representatives of science much more worthy of your approbation; but I know no one, at least, who feels more intimately the sentiments of profound gratitude for the noble welcome which England has accorded for so long a time, nor do I know one who bears so sincere a veneration for Faraday.

The name of your illustrious fellow-countryman is not one which any single nation can claim as its exclusive property; his labours and discoveries are as widely recognised in France, in Germany, and in America as in England. Faraday belongs to the whole world. There is not a spot on this earth to which civilisation has penetrated, that does not claim the right of partaking of the respect and gratitude you entertain for him.

Faraday was identified with the scientific movement of the first half of this century; he was one of its principal leaders, and drew in his train a whole host of thinkers, engineers, men of enterprise, and capitalists. Ever contemplating the chaste beauties of nature, and searching into her most hidden recesses, this disinterested philosopher, this deep thinker, scattered broadcast on his path the seeds of the most extraordinary and unheard-of results—such are the electric currents of Faraday that bear our messages, furrowing Europe and traversing the Atlantic—such are those lights, rivalling the sun in brilliancy, which shine forth from our principal lighthouses; and it is even to the gases which he liquefied that hot countries owe the luxury of ice.

In the pursuit of truth alone, he was able to satisfy, as if by accident, the boldest demand of a refined civilisation; and, devoted to the ideal, he sowed the seed of riches, not for himself, for he despised them, but for the profit of trade, which has gathered the fruit.

Faraday is the type of the most fortunate and most accomplished of the learned men of our age. His hand, in the execution of his conceptions, kept pace with his mind in designing them; he never wanted boldness when he undertook an experiment, never lacked resources to ensure success, and was full of discretion in interpreting results. His hardihood, which never halted when once he had undertaken a task, and his wariness, which felt its way carefully in adopting a received conclusion, will ever serve as models for the experimentalist.

The study of nature entirely puts aside conjecture, and places a guard on vague hypotheses; it begins with facts, ascends to laws, and raises itself, as far as the limits of man's intellect will permit, to the knowledge of causes, by the triple means of observation, experiment, and logical deduction. A long familiarity with the exact detail of phenomena can alone give to a man, as to Faraday, the right of being bold; he is, like Faraday, restrained when he has a thorough appreciation of the limits of man's knowledge. It is two centuries ago since Europe received this system of philosophy from Galileo and Newton, characterised at that epoch by the establishment of the Academy of Naturæ Curiosorum, in Germany, which represented the art of observation; in Italy, by the Academia del Cimento, the school of experimental science; and in England and France, by the Royal Society of London and by the Académie des Sciences de Paris, which adopted mathematical science as one of the means most conducive to the knowledge of truth in the domain which is accessible to us.

What an awakening for Europe! After two thousand years, she found herself in the same position to which she was raised by the profound intellect of India, and the acute genius of Greece, by Aristotle, Plato, Archimedes, and their emulators, from which, during those long ages, she was permitted to fall, whilst the work of the assimilation of races was being carried on under the political influence of Rome.

What would have been the result if the learning of the Greeks, continuing its development from the third century before Christ to our own days, had pursued its triumphant march without hindrance? We do not know; no more than we can forecast the material resources of the human race after twenty centuries, nor to what heights the science of nature will have risen, should no social revolution create a breach in its tradition or retard its progress.

Greek art presents inimitable models; Greek philosophy has forestalled the modern schools in all their fearless opinions; and Greek science, not less prolific, paved the way which Europe has followed after long hesitation.

It is not difficult to connect Leucippus, a contemporary of Alexander the Great, who first clearly enunciated the philosophical doctrine of atoms, and the illustrious physicist of Manchester, Dalton, who, at the commencement of this century, founded, upon experiment, the atomic theory of modern chemists. Between these two points, so far removed, there is no intermediate link. Dalton is the son of Leucippus. Thus Cuvier, too, whose inventive genius was greater than that of Aristotle, was the sole inheritor of his spirit of order, his love of method, and his strength of judgment. In the same manner, we may ascend directly from Galileo and Newton, to Archimedes and Plato; the ideas of Faraday, too, on matter, atoms, force, and motion, were those of a Greek philosopher. The Romans did not receive this inheritance from the Greeks; given more to practical pursuits, they did not recognise the fact that these owed their progress to pure theory.

Truth is so beautiful that it deserves every effort a man can bestow to gain it; it is so fruitful that it carries along with it its own recompense. In placing be-

[English Edition, Vol. XX., No. 501, pages 1, 2.]

fore our mind the end, without occupying ourselves with particulars, we find the ordinary details of well-being and riches fall into their proper places.

Has not the atomic theory of Dalton, in assigning limits to phenomena, renewed the whole art of chemistry? Has Lavoisier's theory of combustion ever ceased to direct agriculture, the useful arts, health, and therapeutics? Did not these two philosophers contemplate abstract truth in all its splendour, and after receiving it from above, was it not sufficient for them to cast their eyes upon the earth, to reflect its light, and to spread far and wide its fruitful and exhaustless seed?

Let us, then, continue faithful in the cultivation of science for itself, and trust, without anxiety, that it will bear practical fruit for itself. Our remembrance of the life of Faraday teaches us that moral truth, when implanted in a man's heart, develops, at the proper time, each virtue that life exacts. His labours show us that the same holds good with scientific truth. At the proper time, it produces, as well as many spontaneous fruits, each of those discoveries which civilisation demands.

To a nation ambitious of becoming famous in history, it should be said: "Despise conquest, abandon the pursuit of riches, and seek Truth, for by that your memory will be perpetuated." In like manner it may be said to a people who desire war or fear it, who wish to remain agriculturists or seek the advantages of commerce: "Search for Truth; it will create your means of defence or attack, maintain the fertility of your plains, and furnish your manufactories with resources against competition." The princes of bygone times considered themselves enriched and assured of prolonged youth, if they could obtain an alchemist capable of making gold, and possessed of a panacea against mortality. The nations of the present day, better advised, seek the aid of chemistry, and place in its counsels their hopes of well-being and honest gain: they know the value of artificial soda, chlorine, gas illumination, stearine candles and aniline dyes, and are grateful for the labour and care which these discoveries have cost.

Everything must give way to the laws of nature, and he only who has mastered those laws can control her processes. But the mastery cannot be obtained without a struggle; the fable of Proteus is a true picture of the combat between man, eager for knowledge, and the stubborn guardian, charged with the preservation of the secrets of destiny. Proteus changed himself into a thousand shapes before speaking, and yielded only to the hero who, far from being moved by his transformations, bound him with bands of increasing pressure. Such is nature herself, her answers are always true, but like the ancient shepherd of Neptune's flocks, before allowing Truth to shine forth, she arrays herself in the garments of error, or hides herself behind the phantoms of illusion; and will only assume her proper shape under the determined pressure of a resolute disciple of Science. This indomitable courage was possessed by Faraday in the highest degree.

The struggle for mastery is often prolonged. The whole life of a man does not suffice; the meeting of many philosophers animated by the same idea, or even the labours of different generations devoted to one pursuit, are required for the attainment of success; hence free associations for the cultivation of physical science, and laboratories, where young men full of faith and ardour, working under one head, unite in the execution of such plans as he may invent or approve. Private study, *which* was perhaps best adapted to Faraday's temperament, but which prevented him from establishing a school, has been succeeded by the labours in common of learned societies, and work carried on simultaneously by pupils in the same laboratory. Enlightened countries at last comprehend that all scientific research is a battle to be won, and that every victory increases national power. Intelligent nations no longer deny to scientific men, worthy the name of captain, either arms for the contest, soldiers devoted to their cause, or subsidies for their maintenance. Science is no longer an unrecognised power of which, nevertheless, much is expected; to-day, every government which does nothing for it must expect to be vanquished by rivals, and to receive the censure of posterity for its want of forethought.

When Christopher Columbus set out for the conquest of the New World, did he not require ships, sailors, provisions, and ammunition? How then can the new world of science be conquered without assistance?

For texile manufactures there must be raw material, machinery, workpeople. The best workman in England, left to his own resources, would be unable to make an inch of cloth. It is the same with scientific discoveries; to weave the weft, there must be raw material, laboratories, apparatus, and reagents. The more eminent a scientific man may be, so much the more is he powerless to resolve unaided all the questions which arise in his mind, and to develope all the views suggested to him by the new aspects of nature, which his penetration has reached.

How many *chefs-d'œuvre* might have been lost to us if Raphäel, protected by an illustrious Pope, had not been the centre of a brilliant and devoted school, capable of sparing him the actual labour required to develope his ideas! What discoveries will be made when scientific masters of all countries, raised to their true position, are no longer limited in their resources, confined as to their means of execution, and obliged to do everything with their own hands!

The high position held by Faraday allows of such a comparison, and we may regret the loss of the discoveries which might have been added to those with which he has benefited the world, if, like Raphäel, he would, or could, have founded a school. Learned societies formerly chose as a subject for their solemnities, an encomium on those monarchs or ministers whose protection they enjoyed. This meeting presents a spectacle more in conformity with the dignity of science: Faraday indeed raised himself above his fellows like a prince, but as a prince of thought; he exercised his power like a minister, but as a prime minister of the power and forces of nature.

His life is likewise an epoch of intellectual progress; and our immediate posterity will speak of such and such discoveries as having been made in the time of Faraday; sure of being as well understood as if referring to events in history, as being of the time of Elizabeth or Charlemagne.

But the life of Faraday is known to you, and you are familiar with his labours. I cannot fail of rendering that homage to his memory which he would have desired himself if, together with you, I review the progress of those sciences to which he was devoted.

Since the commencement of this century, three nations, animated with a noble spirit of rivalry—England, Germany, and France—have been contending for the first place in the study of physical science. Warranted, by turns, in claiming superiority, no one of them has dreamed, for one instant, of abdicating its claims.

From this generous strife have sprung innumerable labours, the boast of our age, which will imprint a character upon it in history.

I do not wish to review, nor even to point out, the advantages that these nations have received from the liberal hand of science, but to bring before our minds the acquisitions to our knowledge of matter and force, to point out those fundamental ideas which have been brought to light, and to call to mind the part we must attribute to Faraday in this wonderful movement. I propose, then, to examine what we have learnt with regard to—1st, the nature of concrete matter; 2nd, the forces which it obeys; 3rd, the nature of truly-organised matter; 4th, the force which animates it.

The Greeks considered all matter divisible into four irresolvable elements, viz., earth, water, air, and fire, which are concrete representations of the abstract ideas solidity, liquidity, gaseous state, heat. So far they were guided by their senses; but they were of opinion that, finally, matter was made up of inaccessible atoms, and that variety, in the number or the arrangement of the latter, accounted for all the varieties in natural substances.

At the present day, with Lavoisier, we give the name of elements to all substances which we cannot break up or resolve; but hold, with Dalton, that these elements are themselves made up of atoms which unite in different proportions, and with varying arrangements, to form different compounds.

To sum up, matter can be reduced to substances which no longer admit of reduction, and these substances are the elements of modern chemists; matter has only three forms, the solid, the liquid, and the gaseous, which stand for the elementary substances of the Greeks; matter is agitated by different motions, which may be all represented by one alone—heat—as all the rest may be transformed into it.

Lavoisier demonstrates that these are substances which cannot be resolved into simpler parts, and these he calls elements; Dalton asserts that the latter are substances combined in unvarying proportions, and he gives the name of atoms to these proportions reduced to their simplest form. Are not the elements of Lavoisier subject to decomposition in their turn? Cannot the methods recognised by Dalton be brought under a more general statement? May not chemistry be in the same state as astronomy with Kepler's laws, and is it not waiting for its Newton?

We are inclined to believe in the absolute simplicity of Lavoisier's elements when we consider,—1st, that, since the commencement of civilisation, no power at man's disposal, no natural action observed by him, has been able to break them up; 2ndly, that when converted into gas, their atoms occupy the same space as before; 3rdly, that in the solid state their atoms have the same volume when we deal with analogous elements; 4thly, that in the last case their forms are identical, so that they can replace and displace one another mutually in their compounds, without any great change of properties; 5thly, that the heat required by atoms for a change of temperature, is the same, no matter how they differ in weight; lastly, that in order to separate them when united, any atom whatever requires the same amount of electricity as any other. But, with the exception of inalterability, all these properties, not excepting the last, one of Faraday's best discoveries, are found in all compounds of the same order; we have, then, only a right to say that Lavoisier's elements are substances of the same order, and if we may say that they *cannot* be resolved, it is only because they *have not* been resolved.

We are inclined to think Lavoisier's elements further reducible from considering—1st, their number, which has risen in less than a century from thirty-one to sixty-five, and which grows rapidly; 2nd, their natural classification by families, the different numbers of which approach gradually, like terms in a continuous series 3rd, their indubitable analogy with organic radicals, which are compounds.

In this way, Faraday's idea, that the atoms composing simple substances are collections of centres of force diversely arranged, may be defended. Chemical atoms would be the starting-point of the analysis; mechanical atoms its last stage.

However, the question has entered upon another phase since the most recent discoveries. Natural philosophy has enabled us to determine the elements which are in incandescent matter, by means of the character of the spectrum formed by the latter.

The fact that Lavoisier's elements have resisted for the millions of years that they have been on the earth all the efforts of nature and of man to reduce them, is a characteristic of simplicity. Now we can say that these elements have resisted every effort at destruction in space as well as in time. We find in the sun, in the fixed stars, in the nebulæ, and in comets themselves—that is, within our system and without our system—the elements which we have known on earth; we find the same metals, hydrogen, nitrogen, &c.

When we are taught by the beautiful discoveries of Messrs. Janssen, Lockyer, and Frankland, that the protuberances on the sun are only incandescent hydrogen, we ask, How shall it be possible to reduce this element if the temperature of the sun do not suffice for its reduction?

As far as man can go back in time, as far as man can reach by observation in space, the concrete elements of matter present the same character as Lavoisier's elements.

In their abstract forms, reduced to mere centres of force, these elements, if such be the name for matter in its final state, belong to an immense tract, and soar up into a region of thought, inaccessible to man both in space and in time.

The examination into the modifications which have taken place in our ideas on the subject of force authorises us in going back to an age long before the commencement of this, for from thence the changes in our ideas take their date. Then matter used to be placed under the dominion of universal attraction, of motion, of light, of heat, of electricity, of magnetism, of chemical affinity, of cohesion, of the force of solution, of capillary attraction, and, later, of endosmose, &c.

It was no longer the philosophy but the mythology of Greece that served as a model. Natural forces occupied the position with regard to modern science that the divinities of old did with respect to Olympus, and people came to attribute to the former, as they had done to the latter, distinct and inalienable personalities.

At the present day, we know that light and heat have many properties in common, that electricity can be changed into magnetism, and *vice versa*, and that mechanical action can produce heat, magnetism, electricity, light. This correlation of physical force, as Mr. Grove cal's it, the data for which were given by Ampère, Melloni, and before them by Sady Carnot, and confirmed by the crucial experiments of Faraday, remove all doubt. These forces are different modes of

motion, and all these modes of motion can be transformed one into the other.

The man with vulgar cravings sought for the transmutation of matter, and failed to find it; he had little care for the transmutation of forces, the deep meaning of which none but the philosopher understood, and as a reward for the disinterestedness of the latter, the truth was revealed to him.

One of my most eminent fellow-labourers, one of my countrymen who has many friends here, and whom you have heard in this theatre, M. Henry Ste. Claire Deville, has just proved the existence of a close alliance between affinity and mere physical attraction, by the discovery of dissociation, which will influence the progress of chemistry materially.

We cannot deny that there exists close relationship between affinity on the one hand, and mechanical force on the other, when we see the decomposition of a body, such as marble when submitted to the action of a steady heat, come to a stand in the same way and from the same causes as the vaporisation of a liquid *in vacuo*.

This is the first step that has been taken to bring chemical phenomena under the laws of mechanics, and to justify Newton's view that chemical attraction was a particular case of universal attraction.

Has not Mr. Graham, in turn, reduced to causes purely mechanical the manifold effects of diffusion, of endosmose, of capillarity? Has not this illustrious philosopher been led by his latest researches to manifest, not only the metallic character of hydrogen by a memorable discovery, but to seize the very moment at which the phenomenon of the mechanical condensation of a gas by a porous body changes into a truly chemical combination?

There remains, then, universal attraction which, acting on heavy bodies, guides the motion of the stars as well as that of atoms; a motion which produces heat, light, electricity, and magnetism.

The study of matter leads us to the knowledge of an ever-increasing number of elements, and of simpler and simpler forces. Matter which was always believed to be conceptible and susceptible of transmutation, has resisted the efforts of man; whereas physical forces which were considered to be beyond his reach are shown to be ephemeral, and change one into the other readily.

But what relation connects gravitation with the other forces in nature? We know not; and Faraday, who has meditated on this point all his life, and who has thrown such vivid light on all its surroundings, has not made one step towards the solution of the problem.

What is the cause of gravity itself? We now know no more than was known two hundred years ago, in Newton's time.

What is meant by organic matter? If one were influenced by the views of the old chemistry, there would be no difficulty in replying. All organic matter originated in plants or animals; it was destructible by heat; it contained, generally, carbon and hydrogen, often oxygen, sometimes azote. Thus it was a compound of which carbon formed the fundamental element, destruction by fire the chief characteristic, but which, above all, derived its organic character from the circumstances of its origin.

At that time, no one thought of confounding organic chemistry and mineral chemistry. At the present day, division exists in all purely chemical substances; only the terms of this assimilation are not understood. We are dazzled by a quibble. My age, and the share I have had in this movement in science, compel me to explain clearly my opinion, and to endeavour to put an end to the misconception.

The first studies we pursue on the chemical phenomena of life teach us that plants create, and animals destroy, organic matter. The sun appears as the agent by whose means this matter is produced, and combustion by the air that animals breathe, as the process that destroys them, in order to restore their elements to the state of "brut" matter.

The chemical forces placed at the disposal of life, descending on the earth under the forces of light, disappear by radiating off into space under the form of heat. An equilibrium obtains between the vegetable and animal kingdoms for receipts and disbursements, represented by these two forms of motion—light and heat; and the amount of animal life which may be developed on the globe is measured by the amount of food that vegetable life has prepared for it. The dark rays of heat appear to carry off from the earth that which radiant and brilliant light has spread over it.

On looking more closely into it, however, it was found that matter of organic origin was divided into two groups; one so rich in species that it surpasses all that has ever been imagined of the very numerous species of plants or animals described by naturalists; the other containing but a very few distinct species.

The first group constitutes the true organic species of chemists; that is to say, those which they have analysed, of which they have recognised the constitution, which they make by means borrowed from their own sciences, and of which they can, consequently, define the nature by analyses and syntheses.

Let us first attend to these matters. At what moment can they be characterised as organic?

Their origin does not suffice. In fact, carbon, hydrogen, oxygen, azote, can be withdrawn from plants or animals, and no one would find anything but mineral elements.

Oxide of carbon, carburetted hydrogen, cyanogen, water, and ammonia may meet in the produce of the constituents of plants or animals without any one thinking of making organic substances from these binary compounds. But old chemists gave this name to alcohol, to vinegar, to the essence of bitter almonds, to urea, for example. Now, if there is any certain principle in science, it is this. Alcohol, vinegar, essence of bitter almonds, urea, although proceeding from plants or animals, have never lived, and will never live. They are subordinate products of life; they are not necessary instruments of life.

With regard to them, chemistry need no longer hesitate. This matter is formed in the manner of mineral matter. It shows all the conditions of its composition, its structure, and its properties. One circumstance only distinguishes it, and that, even, is not absolute. Generally, mineral matter is formed of simple elements, directly united. However, we perceive sometimes that certain composite groups may act like elements, may replace them or be replaced by them in combinations, without the latter changing their general character.

That which is the exception in mineral chemistry becomes the rule in organic chemistry. Lavoisier had the presentiment of this when he wrote—"Organic chemistry is the chemistry of compound radicals."

At this day, there is no longer any doubt. Cyano-

gen, cacodyle, the metallic radicals of Dr. Frankland, are well-known substances, offering all the chemical qualities of simple bodies, and nevertheless compound.

The substitutions admit of displacing and replacing one element by another, or even, at pleasure, by a compound radical in all the organic matter of chemists without changing its type. The converse is true: there is no impediment to replacing a compound radical by an element in a combination; and this change does not alter the type of it more.

Thus, the organic materials of which we speak are similar in all their conditions or qualities to mineral materials; 1st, they contain certain compounds which play the part of elements; 2nd, they assimilate with the oxides, sulphides, chlorides; with acids, bases and mineral salts in all their properties; 3rd, their radicals can replace the mineral elements, and be replaced by them; 4th, they can replace each other reciprocally.

Like "brut" bodies, these materials are susceptible of crystallisation, of volatilisation, without becoming decomposed; they form definite combinations, are incapable of life, and never have lived.

They thus resemble mineral matter in every respect, and where they differ from it is only that they have the general principles of compound radicals, whilst the mineral species have generally the principles of elements.

Analogies are even apparent in some numerical relations known to the elements of mineral chemistry, and to the radicals of organic chemistry. These relations are manifest in the two cases, for all elements susceptible of being arranged in series or natural families.

Thus, lithium, sodium, potassium, whose respective atomic weights are 7, 23, and 39, form a series of which the difference is 16. Magnesium, calcium, iron, whose respective atomic weights are 12, 20, 28, form a series whose difference is 8.

Thus all organic radicals offer the same condition. Methylium, ethylium, propylium, butylium, &c., give a series whose difference is 14, their respective atomic weights being 15, 29, 43, 57.

It seems natural to conclude from all this evidence, not that substances thus endowed and composed are organic because they are derived from organised beings, but rather that the elements of mineral chemistry may be complex.

In any case, the assimilation of the two chemistries becomes more and more near.

This picture would be incomplete if we did not add a few more features.

The radicals of mineral chemistry formerly numbered 30, and the combinations known in nature raised the number to some hundreds; at this day we count 65 elements, and some thousands of compounds or natural mineral species.

The chemist of the last century might study them one by one, and become acquainted with them all. Such is not the mission of the chemist of the present day; the species being realised, he tries to study them in groups; the potential species he tries to create. In nature, every element produces, on an average, eight or ten species. In the laboratory, every element may form thousands of the same order as the known mineral species.

The contrast is still more striking in organic nature. The animals and plants which cover the surface of the earth are counted by hundreds of thousands, and yet their tissues and their juices, submitted to chemical analysis, resolve themselves into no more than a few hundreds of distinct chemical species.

But the power of combination is such, among the special elements which form them, that it is by thousands that they have arisen; and if we calculate the number of combinations of this kind which may be realised, it seems as easy to count the grains of sand on one of the great shores of the sea as to say to what number of figures may be raised the organic species which the chemist has to produce.

Thus mineral or organic species, counted formerly by hundreds, are now counted by thousands for the first and by millions for the second.

Whence comes this fecundity for the formation of the so-called organic substances? Many circumstances contribute to it; but the first results from the almost incalculable number of the compound radicals which it can realise. Each of them being able to give birth to a prodigious number of combinations, organic chemistry counts a very great number of heads of tribes, and each tribe an infinite number of species. The latter, already multiplied in fact for simple radicals, are much more so by the consequences of the fertile discovery of Mr. Williamson, which has taught us to unite two different radicals to each other, to bring them into a single system, and to produce with the latter as numerous compounds as were obtained from each of the isolated radicals. In consequence of the first and fundamental discovery of Mr. Graham, on the triple functions of phosphoric acid, which has been extended to the domain of organic chemistry,—for acids by M. Liebig,—for bases by M. Berthelot,—for alcohols by M. Wurtz, the result of this harmony of work, of which the immensity alarms the imagination, is that the atomic compounds with which we were chiefly engaged forty years ago, have not only been multiplied, but that they have been repeated by counterproofs. One might say, without forcing a metaphor, that we had visited and described all the rooms of the ground floor of the building; that Messrs. Graham and Liebig have revealed to us the existence of a first and second story, which repeated all their arrangements, and that Messrs. Berthelot and Wurtz have shown us that it was the same case in the basement and in the cellars. Thus five times more chambers or species have been produced at pleasure.

But, from all the sources of multiplication of substances with which organic chemistry is concerned, the most fertile is that of substitution; in fact, the discovery of the compound ammonias by M. Wurtz, and the labours of M. Hofmann which resulted from them, have produced a multitude of combinations, in which the atoms of hydrogen contained in ammonia are replaced by compound atoms performing the function of elements—that is to say, by organic radicals. If we apply the calculation to this special case, we even see that, with the known radicals employed to replace entirely, or in part, the hydrogen, or to replace each other mutually, we should henceforth be able to produce compounds derived from ammonia by hundreds of thousands or by millions.

How if we were to apply the same calculation, and the same provision to all the types?

There is yet more. The chemist is not now, as formerly, obliged to derive all the substances that he produces by these means from those yielded by animals and vegetables; he creates them at will; he no longer needs, for his starting-point, the action of solar light on plants. When he wishes to produce organic substances, he obtains his force by employing heat, formerly regarded as the true means of destroying them.

Not that he has succeeded in directly uniting carbon, hydrogen, oxygen, and nitrogen, so as to form organic substances; but, by the aid of heat alone, he first combines them two and two, and he thus forms carburetted hydrogen, carbonic oxide, cyanogen, water, and ammonia. Afterwards, by subjecting these first compounds to the action of suitable substances, and by the necessary artifices, he succeeds in regenerating, little by little, all the definite compounds of organic chemistry.

There is not a chemist who has not performed syntheses of this character; but the most striking is that of urea, by M. Wöhler; and the first, which have been grouped in a systematic manner are those which have been performed in Germany, by M. Kolbe; and especially those performed in France, by M. Berthelot, who has worked at them with great success, being the first to reproduce formic acid, and to combine directly carbon and hydrogen.

The function of the chemist changes, and becomes elevated. In presence of the numerous substances that his power evokes from the regions of the unknown, he owes his first attention to order, method, classification, and to nomenclature. But, once this first duty is fulfilled, he contemplates this innumerable host of forms, raised by his conceptions, or realised by his hands; and he applies to mathematics for a definition of the harmonies of numbers therein revealed; to mechanics, for a statement of the laws which their structures obey, or those which determine the stability of the material systems which they represent.

The Bible tells us that when God had formed, from dust, all the beasts of the earth, and all the fowls of the air, he made them pass before Adam, and that the name given to each by Adam is its true name.

In presence of this new creation, not of animated beings — whose appearance on earth depends on a power superior to his—but of harmonious forms which chemistry reproduces at will, always identical with each other, and always distinct from all others, man might sometimes forget that he has no longer merely to give names to the works of God, in order to remember that he has to name his own works.

If the discoveries which we have witnessed during the last half century do not justify pride, they at least excuse it. But, to bring back man to our appreciation of truth, it suffices to tell him that—if he has become more expert in the art of observing, if he employs with more certainty the art of experimenting, if the logic proper to the sciences leads him more surely to the discovery of the laws of nature—he has not as yet advanced one step towards the knowledge of causes.

Let us consider, in particular, what he knows on the subject of the materials which his life sets in motion in its development, and the contrast will be striking.

If I question the physiologist, on the subject of these millions, or milliards, of compounds, misnamed organic, of which the chemist transforms, reproduces, or creates at pleasure the species, he will reply to the three following questions:—Are these compounds living?—No! Have they lived?—No! Are they capable of living?—No!

If I ask the chemist himself if these compounds belong to mineral chemistry—to the chemistry of raw (brut) substances—he will reply, Yes!

Organised matter, not capable of being crystallised, but destructible by heat, the only matter which lives, or has ever lived—this matter, a subordinate agent of *the vegetating power* in plants, of the motion and sensation of animals, cannot be produced by chemistry; heat does not give birth to it; light continues to engender it under the influence of living bodies.

Let us not be disturbed by a quibble. The ancients admitted that nature alone produces organic matter, and that the art of the chemist is limited to transforming it. To-day we might, perhaps, even pretend that chemistry is powerful enough to replace, in all respects, the forces of life, and to imitate its processes; let us keep to the truth.

The ancients were mistaken when they confounded, under the name of *organic matter*, sugar and alcohol, which have never lived with the living tissue of plants or the flesh of animals. Sugar and alcohol have no more share of life than bone-earth, or salts contained in the various liquids. These remnants, or rubbish of life, placed amidst organic matter, are true mineral species, which must be brought back to, and retained amongst, "brut" bodies. Chemistry may produce them in the same sense that she manufactures sulphuric acid or soda, without, for all that, having penetrated into the sanctuary of life.

This subject remains what it was — inaccessible, closed. Life is still the continuation of life; its origin is hidden from us as well as its end. We have never witnessed the beginning of life: we have never seen how it terminates.

The existing chemistry is, therefore, all-powerful in the circle of mineral nature, even when its processes are carried on in the heart of the tissues of plants or of animals, and at their expense; and she has advanced no further than the chemistry of the ancients, in the knowledge of life and in the exact study of living matter; like them, she is ignorant of their mode of generation.

Where, then, is true organised matter, or matter susceptible of organisation? What is its chemical constitution? What is its mode of production? What is its manner of growth?

Instead of myriads of species, one would feel disposed to recognise but eight or ten at most, if one may be allowed to consider elementary types of organisation as chemical species. Be this as it may, in the origin of beings which have life we see cells appear, and in the heart of their types we find cells for organic elements, and, still beyond these, germs of cells.

In these cells, or in the spaces between them, we observe inert products, aliments, excretion, substances stored up. It is the cell, it is the germs which proceed from life, which live, which engender life, and then die. The substances which are contained in, or which surround these organs, are subordinate accidents, products rejected by organisation, or destined to its use, but distinct from life.

Every organised being is born of a germ; every plant from a seed; every animal from an egg. The physiologist has never seen the birth of a cell, excepting by the intervention or as the produce of a mother cell.

The chemist has never manufactured anything which, near or distant, was susceptible even of the appearance of life. Everything he has made in his laboratory belongs to "brut" matter; as soon as he approaches life and organisation, he is disarmed.

Thus, for a century past, the empirical elements of matter have been recognised and separated; their combinations have been multiplied to infinity; physical forces have been brought back to a common origin—motion—and one has been at pleasure changed into the other; and yet—

Is the intimate nature of matter known to us? No! Do we know the nature of the force which regulates the movement of the heavenly bodies and that of atoms? No! Do we know the nature of the principle of life? No!

Of what use, then, is science? What is the difference between the philosopher and the ignorant man?

In such questions the ignorant would fain believe they know everything; the philosopher is aware that he knows nothing. The ignorant do not hesitate to deny everything; the philosopher has the right and the courage to believe everything. He can point with his finger to the abyss which separates him from these great mysteries,—universal attraction which controls "brut" matter, life which is the source of organisation and of thought. He is conscious that knowledge of this kind is yet remote from him, that it advances far beyond him and above him.

No, life neither begins nor ends on the earth; and if we were not convinced that Faraday does not rest wholly under a cold stone, if we did not believe that his intelligence is present here among us and sympathises with us, and that his pure spirit contemplates us, we should not have assembled on this spot, you to honour his memory, I to pay him once more a sincere tribute of affection, of admiration, and respect!

ON JARGONIUM;

A NEW ELEMENTARY SUBSTANCE ASSOCIATED WITH ZIRCONIUM.*

BY H. C. SORBY, F.R.S., ETC.

AT the *soirée* of the President of the Royal Society, on March 6th, I exhibited various spectra, differing so much from those characteristic of any known substance that I considered myself warranted in concluding that they were evidence of a new element. Since this may be studied to the greatest advantage in the jargons from Ceylon, it appeared to me that, as the name *zirconium* has been adopted for the principal constituent of zircons, so that of *jargonium* would be very suitable for this constituent of jargons.

At the above-named *soirée* I gave away a printed account of the objects I exhibited; and in this I said that jargonia "is distinguished from zirconia and all other known substances by the following very remarkable properties. The natural silicate is almost, if not quite, colourless, and yet it gives a spectrum which shows above a dozen narrow black lines, much more distinct than even those characteristic of salts of didymium. When melted with borax it gives a glassy bead, clear and colourless, both hot and cold, and no traces of absorption bands can be seen in the spectrum; but, if the bead be saturated at a high temperature, and flamed, so that it may be filled with crystals of borate of jargonia, the spectrum shows four distinct absorption bands, unlike those due to any other known substance."†

I have since applied myself almost exclusively to the study of this substance, hoping to have been able to communicate to the Royal Society a full account of the subject this session; but so much still remains to be done that it is now impossible to do anything more than give a brief outline of the more important facts. The delay has not been because there is any difficulty in proving it to be a new substance, but because its properties are so unique, and have so much interest in connection with physics, that it appeared desirable to carefully examine all other known elements, in order to ascertain whether any of them exhibit analogous phenomena. That jargonium is quite distinct from zirconium is not only proved by the spectra, but also by other facts. Both myself and Mr. David Forbes have succeeded by entirely different processes in separating from jargons, zirconia apparently quite free from jargonia, and jargonia nearly, if not quite, free from zirconia; and, even if the separation be not perfect, it is, at all events, more than sufficient to prove that they are quite distinct. They are certainly very closely related, and are deposited from borax blowpipe beads in microscopical crystals of the same general form,* quite unlike those characteristic of other known earths; but beyond this the difference is as great as that between any other two allied elements. Judging from an analysis kindly made at my request by Mr. David Forbes, and from a comparison of the spectra, the amount of jargonia in jargons varies up to about 10 per cent. The entire or comparative absence of jargonia from the zircons of Miask, Fredericksvärn, and various other localities, appears to explain some of the facts which led Svanberg† to conclude that zircons contain more than one earth. He was so far correct, but failed to establish the existence of any substance with special chemical or physical properties; and if, as is probable, the Norwegian zircons, which, according to his views, contain such a notable quantity of this supposed new earth, as to have led him to give it the name *noria*, were from Fredericksvärn, and if the Siberian were from Miask, his norium cannot be looked upon as equivalent to my jargonium, which is almost or quite absent from those zircons.

The most remarkable peculiarity of jargonium is that its compounds may exist in three different crystalline states, giving spectra which differ from one another as much as those due to any three elements which give the most striking and characteristic spectra. Several substances can be obtained in two different physical states, giving different spectra, but usually only one of them is crystalline. The other is the vitreous or calloid condition. Crystalline minerals coloured by oxide of chromium do indeed show spectra of two different types; but, as far as I have yet seen, they never occur in the same mineral. In the case of jargonium, however, there are no less than *three* types of spectra, which are all met with in different crystalline modifications of the *self-same* compound.

The most characteristic test for jargonia is the spectrum of the borax blowpipe beads seen with a spectrum microscope, which enables us to detect it in zircons apparently containing less than 1 per cent. As much of the earth or natural silicate as will completely dissolve should be melted in a circular loop of platinum wire about ⅛ inch wide, with a mixture of borax and boric acid, and a strong heat kept up till crystals begin to be deposited, owing to the loss of the solvent by volatilisation. On removing the bead from the flame it remains clear and shows a few acicular crystals, but gives no absorption bands. On reheating to a temperature just below dull redness, the bead turns white; and so

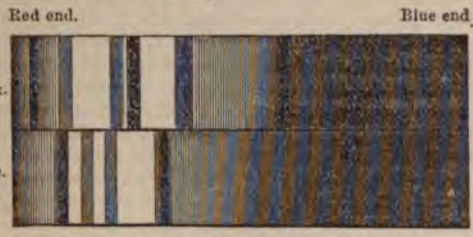
* Communicated by the author, having previously been sent to the Royal Society.

† For the further history of this subject, see Prof. Church's papers—*Intellectual Observer*, 1866, vol. ix., p. 291; CHEMICAL NEWS, March 12th and 19th, 1869, vol. xix., pp. 121 and 142 (*Am. Repr., May*, 1869, *pages* 231, 259); *Athenæum*, March 27th; and also my own—CHEMICAL NEWS, vol. xix., p. 122 (*Am. Repr., May*, 1869, *page* 231); and *Athenæum*, April 3rd.

* See *Monthly Microscopical Journal*, June, 1869.

† *Pogg. Ann.*, 1845, vol. lxv., p. 317.

very opaque that no ordinary light will pass through it. When, however, a small and very bright image of the sun is formed in the centre by means of an almost hemispherical lens of ¼ inch diameter, and a cap is placed over the object glass, with a round hole of less diameter than the bead in the focus, so as to prevent the passage of extraneous light, the bead is seen to be illuminated by transmitted light of about the same brilliancy as that of a bright cloud, so that it gives an excellent spectrum without being at all dazzling.



In the case of beads containing jargonia, the character of the spectrum differs completely according to the temperature at which the included crystals are deposited. As already mentioned, the clear glassy bead gives no absorption bands; and when the crystals of the borate are deposited at as low a temperature as possible, much below dull redness, and only just sufficiently high to soften the borax, there may be scarcely any trace of bands; but if the clear bead be quickly raised to a temperature just below that of very dull redness, it suddenly becomes very opaque, and shows a spectrum with a number of remarkably distinct absorption bands (Fig. 1). The most distinct and characteristic is that in the green, then one in the red and one in the blue, and there are three others fainter, one in the orange and two in the green. On raising the temperature to bright redness, all these vanish and four others appear, none of which coincide with any previously visible (Fig. 2). Three are situated in the red and orange and one in the green, so as to give rise to a spectrum of an entirely different character.* In this state the bead is of a pale straw colour, and not almost white as before. In the case of nearly pure jargonia the beads should not be above 1-25th of an inch thick, or else they would be too opaque. Pure zirconia gives no bands whatever in any state, and the beads are white, and sufficiently transparent when two or three times as thick as just named. It might be thought that these three different spectra were due to different compounds of boric acid and jargonia, if it were not that there is a similar series in the case of the natural crystalline silicate. Some of the jargons from Ceylon have a specific gravity very little inferior to that of pure zircons (4·70), and contain very little jargonia; but those of low gravity (4·20, or thereabouts) contain perhaps nearly 10 per cent, in a state which gives scarcely any trace of absorption bands. After keeping such at a bright red heat for some time, the specific gravity increases from about 4·20 to 4·60; and, judging from the imperfect data now known, this indicates that the volume of the silicate of jargonia is reduced to about one-half. The hardness becomes somewhat greater, and when examined with the spectrum microscope, the spectrum is found to be entirely changed. Instead of a mere trace of bands, a spectrum is seen which is more remarkable than that of any clear and transparent substance I have ever examined, with thirteen narrow black lines and one broader band.* No such changes occur in zircons free from jargonia, like those from Miask—no absorption bands are developed, and there is no increase in their specific gravity. In all cases this varies simply and directly as the amount of jargonia which passes from one state into the other; and if the bands are very distinct before ignition, the gravity is high and not much altered by heat.

Zircons, in their natural condition, from various localities, vary much in both the absolute and relative amount of these two modifications of jargonia; and there is good reason to believe that this difference in physical state may assist us very materially in determining the temperature at which certain rocks have been formed. Fortunately, I have met with one example of the third form of spectrum. A brown-red zircon, from Ceylon, was so dark in one part that I was not able to ascertain what sort of spectrum it would give in its unaltered condition. On heating to redness, the whole became a clear pale green; and, without examination with the spectroscope, no one would have suspected any difference between the different portions. That which was originally pale then showed the spectrum usually characteristic of heated jargons, whilst that which was originally very dark showed one entirely different, corresponding exactly with that of the borate deposited in blowpipe beads at a medium temperature. It also corresponds in general character, but not in detail, with that of the blue spinels from Ceylon, which I believe contain a small quantity of jargonia. That part of the zircon which gives this spectrum appears to have had the same remarkably low specific gravity of about 4·0, both before and after ignition, as though the volume of the silicate of jargonia in this state were even greater than in that which gives no bands.

These various spectra of jargonium are all of a very marked character, quite unlike those due to any other element in similar conditions.

The change produced by heating the jargons is, to some extent, analogous to what occurs on heating arragonite, but yet differs in many most important particulars. When arragonite is thus changed into calcite, it becomes an opaque mass of small crystals, the specific gravity and hardness are diminished, and there is no difference in the spectra of these two different modifications of carbonate of lime; whereas, after heating, the jargons are still as simple and transparent crystals as at first, the specific gravity and hardness are increased, and the spectrum totally changed. Iodide of mercury is an excellent illustration of a difference in the spectrum due to a change in the crystalline state, produced by heat; but there are only two modifications—the scarlet and the yellow. The existence of three crystalline conditions is, in some respects, analogous to what occurs in titanic acid. Anatase, brookite, and rutile are three distinct crystalline modifications of the same substance; but they do not differ very much in specific gravity, and their spectra do not present any characteristic differences. On the whole, the different states of carbon—charcoal, graphite, and diamond—are, perhaps the best illustration of the existence of three distinct modifications, which differs much in specific gravity and optical characters; since one is black, the second has a metallic lustre, and the third is colourless and transparent; but these are variations in the element itself, and not, as in the case of jargonium, modifications

* June 30th.—I have since been able to examine these spectra with unusually good light, and have found another band in the blue in spectrum *Fig. 1*, and another in the extreme red in spectrum *Fig. 2*.

* Chemical News, vol. xix., p. 122 (*Am. Repr.*, *May*, 1869, *page* 232).

of its compounds. So far as I am aware, there is indeed, no substance which shows strictly comparable facts.

There cannot, then, I think, be any doubt whatever that jargonium is not only a new elementary substance, but is, also, one likely to throw much light on several important physical questions. By the time that the Royal Society resumes its meetings, I trust that I shall be able to send a complete account of the whole of my investigations, including such facts connected with other substances as may serve to illustrate the very peculiar properties of this hitherto unrecognised element.

Postscript (June 16th).

Since Professor Church has published some papers on the existence of a second earth in some zircons, it may perhaps be well to give a short account of what he has done. He was the first to observe the absorption bands, and gave an account of them in the *Intellectual Observer* for May, 1866 (vol. ix., p. 201). In that paper he said nothing about a *new* elementary substance, and does not even seem to have been convinced that they were not due to zirconia, since he speaks of silica as "the other constituent of zircons," as though there were but two constituents—silica and zirconia. However, since he had found that some zircons show the bands much better than others, he said that he was "induced to hazard the conjecture that it may be, after all, the presence of Svanberg's *norium* which determines the difference." I have now shown that jargonia may exist in very considerable quantity in zircons in such a physical condition as not to show any bands, and it was quite as probable that their presence or absence might have been due to a similar variation in the physical state of zirconia itself; and therefore no fact described in Professor Church's paper can now be looked upon as proof of the existence of a second earth. His paper does not appear to have attracted much attention, and I was quite ignorant of it until after I had printed, for distribution at the *soirée* of the Royal Society on March 6th, an account of the characteristic peculiarities of jargonia. Up to that time he had never so much as even suggested the existence of a *new* earth, and the first time that he did so was in his paper subsequently published in the Chemical News of March 12th (*Am. Repr., May*, 1869, *page* 231), manifestly written because he had "heard, when in London, that Mr. Sorby had discovered a new set of black absorption bands in certain zircons, and had attributed their occurrence to the presence in the stones examined of a new element accompanying zirconium." In this paper he suggested that the name *nigrium* might be appropriately adopted, but did little more than recapitulate the arguments previously brought forward by Svanberg in proof of the existence of *norium*, viz., a difference in the specific gravity of the zircons, in the atomic weight of the earths, and in some obscure and doubtful chemical properties; but he never proved that the bands might not have been due to several well-known elements, and that the above-named differences depended on the substance which gives the peculiar spectrum. I therefore maintain that I was the first, not only to suggest, but also to prove, the existence of a new element by my blowpipe methods, and to show that the earth may be separated from zirconia and obtained in a state of approximate purity.

Postscript (June 18th).

I here subjoin a brief account of the methods employed by Mr. David Forbes* and myself in separating zirconia and jargonia from one another. He separated apparently pure zirconia by means of strong hydrochloric acid, which dissolved the chloride of jargonium, but left chloride of zirconium undissolved, and obtained the approximately pure jargonia by adding to the solution excess of ammonia, and then considerable excess of tartaric acid, which left most of the tartrate of jargonia insoluble, but dissolved what may turn out to be a mixture of zirconia and jargonia with a third substance not yet sufficiently studied—perhaps Svanberg's noria. My own analysis was only qualitative. I fused powdered jargon with several times its weight of borax, which gave a perfectly clear glass, completely soluble in dilute hydrochloric acid. After separating the silica in the usual manner, a slight excess of ammonia was added to the hydrochloric acid solution of the earths, and then some oxalic and hydrochloric acids, which left undissolved apparently pure zirconia that had passed into an imperfectly soluble state. To this solution so much ammonia was added as to give a very copious precipitate, but yet to leave the solution with a very decided acid reaction. After removing the precipitate, which was chiefly oxalate of zirconia, almost or quite free from jargonia, excess of ammonia was added to the solution, and the washed precipitate digested in dilute hydrochloric acid to remove peroxide of iron. The insoluble portion must have been approximately pure oxalate of jargonia, for it gave the characteristic spectra described above in remarkable perfection. Though this method succeeded far better than I anticipated, I do not yet understand the exact conditions requisite to ensure success, and have been prevented by absence from home from making further experiments.

ON HEAT TREATED AS A SCIENCE OF KINETICS.†

BY G. F. RODWELL, F.C.S.

We are surrounded by actions which we cannot readily recognise. There are actions of the nature of those which constitute light—differing not in kind, and but slightly in degree—which are unseen; there are other actions, similar to those which constitute sound, which are unheard; and others, again, similar to those which constitute heat, which are unfelt. Vast ranges of phenomena are beyond the direct cognisance of the senses. The organs by which external impressions are received and conveyed to the brain, although admirably perfect, —I need not say far *more* perfect than our most delicate and refined instruments—are yet, be it remembered, exercised solely in regard to the welfare of the organism of which they form a part. They are devoted to that organism, and exist for the purpose of enabling it to resist adverse assaults, whether of external agencies, or otherwise; to comply with all the demands requisite for the conditions of life, and to transform the external actions of the material world into actions capable of being recognised under some definite form by the centre of perception—the brain. The actions, or motions, which are thus received and transmitted by the nerves, are such alone as are requisite for the well-being of the entire organism. Light, sound, and heat are va-

* Chemical News, vol. xix., p. 277 (*Am. Repr., Aug.*, 1871).

† A course of four lectures delivered at the

rieties of motion; but the nerves of seeing, hearing, and feeling only transmit certain of those motions: if they pass a well-defined limit of quickness or slowness, they cease to be transmitted. But these same relatively quick and relatively slow motions, although incapable of being directly recognised by us, do not the less profoundly influence matter. It is the object of natural philosophy to investigate *all* the actions by which matter is influenced.

Thus our senses are limited in their capability of observation. Their operations are finite. Hence, when we pass from the influence of the so-called *physical forces*—light, heat, electricity, chemical action—upon ourselves to their influence upon matter external to ourselves, it is necessary for us to assist and exact the capabilities of the senses in the particular direction required, and to free the intellect from impressions produced by unaided observation, the bias so resulting, and from the *idola specus* of which Bacon speaks, for we have all of us in our minds "*specum sive cavernam quæ lumen naturæ frangit et corrumpit.*" It therefore behoves us when we study natural philosophy—specially any branch of it submitted to a mode of treatment more assimilable with reason, but less so, perchance, with unaided observation than some older and long-dominant system—it behoves us, I say, to receive with caution, and to carefully examine and analyse the impressions conveyed to us by our unassisted senses, and to put from our minds all preconceived notions, whether derived from directly-received impression, or indirectly from the authority of some older physical system; and this I will ask you to do at the outset. And when, as will frequently be the case, I shall have to speak to you of minute, invisible particles or molecules of matter, endued with functions, attributes, and influences, diverse in form, and varied in character, and such alone as we are wont to associate with larger masses of matter, capable of being seen, and handled, and weighed, I will ask you to grant me some faith, and some imagination. If you find difficulty in doing this in this particular direction, remember that every grain of sand upon the sea-shore is a microcosm, sharing in the innate motions which pulsate through the Universe; and remember, further, that there are specks, infinitely smaller than grains of sand, in which a heart beats, and blood circulates, and all the functions of an exuberant vitality are exercised; and thus, by comparing the unknown with the known, faith may be lessened, and imagination not too tensely stretched.

I had intended to have adopted a different name for the subject of this course from that which appears on the syllabus; to have replaced the word *heat* by some term which, as I thought, would better associate in your minds the idea of motion with that of heat; such as *thermo-kinetics* (from θερμος, heat; and κινησις, motion), or *thermo-dynamics;* or to have spoken of it as *a certain motion appertaining to matter.* I had intended to have done this, when, on enquiring into the etymology of our word *heat*, I found that the term is peculiarly appropriate, although the science which it designates has, of late, undergone the most profound changes. The word *heat* is closely related to the Anglo-Saxon *haets*, the Gothic *haitan*, the Icelandic *hita*, and the old High German *eit;* and these words agree, by Grimm's law, with the Greek αιθος, fire, from αιθω, to kindle; mark, also, the related words αιθοψ, αιθυσσω, and (perhaps) αιθηρ. The celebrated philologist, Bopp, carries *back the derivation to a Sanskrit root—indh*, to shine; *and traces it through the Greek* αιθος, the Latin *æstus*, and the old High German *eit*, to our word *heat*. "*Æstus,*" says Vossius, in his "Lexicon Etymologicon," "*est commotio, vel in igne, vel in aqua, vel in animo. Omnis autem commotio fervorem gignit.*" Now, as it will be my object to show that heat *is* a commotion of the small particles or *molecules** of matter, I think you will agree with me that the term could not be changed with advantage.

From an early age, the idea of motion has, in some form or other, been associated with that of heat. I may remind you that, in αιθυσσω, to put in rapid motion, to kindle (from αιθω), we have distinct reference to this; and, moreover, that αιθηρ, from which we have our word *ether*, was sometimes used to express fire. From the supposed proximity of the sphere of ether to the sphere of fire, and the generation of the latter from the former, the ether was sometimes regarded by the ancients as a very pure fire; invisible, all-pervading, and in perpetual motion; indeed, as a something approaching to the nature of what we now call heat. Now if, as Aristotle affirms, αιθηρ is derived from αει, always, and θεω, to move swiftly, we have here additional evidence that, at an early period, the idea of motion was associated with that of heat.

"*Æstus est commotio . . . omnis commotio fervorem gignit.*" I will define heat as a rapid motion of molecules of matter. This motion, when transmitted to the brain by the molecules of the sensory nerves, produces in us the sensation by which heat is familiarly known.

Let us now briefly trace the rise of the two theories which for so long a time prevailed in regard to the nature of heat. Epicurus regarded heat as an effluxion of minute spherical particles which, in virtue of their smallness, and of the rapidity of their motion, insinuate themselves into the densest substances, and thus expand, and eventually disintegrate them. Lucretius, who followed Epicurus somewhat closely, maintained that both light and heat are caused by the vehement motion of small primary particles—*primi minuti*, as he calls them. The majority of the ancient philosophers regarded fire (under which term was included both light and heat) as an element more divine than air, water, and earth; it was to them the acting agent of the Universe, the *force* exercising itself upon *matter*. The function of fire is well signified in the story of Prometheus, who, you will remember, is related to have stolen fire from heaven, and therewith vivified mankind. Fire was the *anima*, while tangible matter was the *corpus*.

The ideas of the ancients regarding the nature of heat were very generally adopted during the middle ages. Cardanus frequently speaks of *motus ignis* and *motus caloris*. Telesius, of Cosenza, a philosopher far in advance of his time, asserted that heat is the cause of motion, cold of rest, and that these principles together produce all the phenomena of the universe. Robert Fludd (also known as Robertus de Fluctibus), the founder of the Fluddists, affirmed that heat is the ultimate effect of the action of light, and that it results from the motion of material particles. Francis Bacon was one of the first to deny the elemental nature of fire, by asserting that it is "merely compounded of the conjunction of light and heat in any substance;" elsewhere he defines heat as "not an expansive motion of the whole, but of the small parts of a body." As an example of the production of heat by the transforma-

* *Molecula*, a little mass; a Low Latin diminutive of *moles*, a mass; a mass of incommensurable minuteness.

tion of visible motion, he mentions that a piece of metal when hammered becomes hot, and that if the hammering were continued, it would possibly become red-hot.*

About twenty years after the death of Bacon, the *Principia* of Descartes appeared. In it we find the development of one of the most comprehensive kinetic systems which has ever appeared in the history of science. (By *kinetic system* I mean a system in which the phenomena of the universe are accounted for on the supposition that they are caused by various motions.) It is impossible at the present time to enter into any detailed account of the Cartesian philosophy. I may mention, however, that Descartes supposed the existence of three elements, by the mutual interaction of which all natural phenomena are produced. The first element, the *materia cœlestis*, corresponding somewhat to the αἰθηρ of the Ancients, is a very subtle medium, possessing perpetual and vehement circular motion, and it is the cause of all the motion in the universe; the second element is more gross, and it embraces all gaseous matter, while the third element embraces all solids and liquids. Thus the first element, which actuates by its motion the second and third elements, corresponds somewhat with what we now call a *force*. Heat, according to Descartes, is a rapid circular motion of the particles of the third element, communicated by the materia cœlestis. The particles of oils and fats, and of combustible bodies generally, are peculiarly adapted to the reception of this motion, and such bodies he designated "potentially hot." Among other passages which bear upon the kinetic theory of heat, I find the following in the fourth book of the *Principia*:—"A nail which is being driven into a block of wood does not become hot until after it has been driven home by the hammer, because heat is not a motion of masses, but of small particles, and so long as the nail itself is capable of moving, the force of the blow is expended in producing the motion of a mass, not in moving the small particles of the metal." The nature of heat, according to the Kinetic theory, received a very apt expression in the following definition given by John Locke:—"Heat is a very brisk agitation of the insensible parts of the object, which produces in us that sensation from which we denominate the object hot; so that what in our sensation is *heat* in the object is nothing but motion."

Towards the close of the seventeenth century, there arose a theory which endeavoured to trace the cause of a number of phenomena to the absorption or rejection of "*materia aut principium ignis, non ipse ignis*," better known as the theory of Phlogiston (from φλογιστος, burnt). This theory profoundly influenced the scientific world for more than a century, and it led to an extended theory of materialised heat.

We thus perceive that there had gradually arisen two distinct theories in regard to the nature of heat, for while some regarded it as a motion of the molecules of matter,—as a condition, or attribute of matter, others regarded it as matter itself, subtle indeed, and infinitely thin, but yet a kind of matter capable of being absorbed or rejected by other and grosser matter. The former of these is the *Kinetic theory of heat*, (κινησις, motion), and is now generally, if not universally, adopted; the latter is the *material theory of heat* (*materia*, matter), and it was almost universally adopted during the last, and far into the present, century.

According to the materialists, substances have heat stored up in them. A metal becomes hot when it is hammered because its particles are approximated, and the heat is, as it were, squeezed out of it, as water is squeezed out of a sponge. The metal, before being hammered, was said to possess a *greater capacity for heat* than the hammered metal. In a similar manner they accounted for the production of heat by friction and percussion; the possibility of procuring new heat was denied, and the amount in the universe was considered incapable of variation.

In 1798, Count Rumford, while engaged in the boring of cannon in the Arsenal of Munich, observed, with surprise, the large amount of heat which was produced during the process, and the apparently unlimited extent of its production. Now, he reasoned, if the explanation of the materialists be correct, it follows that all the heat observed in the cannon, and in the separated borings, results from the altered capacity for heat of a few ounces of metal borings. But, on examination, they were found to possess precisely the same capacity for heat as an equal weight of the solid metal, hence the explanation offered by the materialists was clearly fallacious. Rumford afterwards constructed a special machine for the production of heat by friction. It consisted of a metal cylinder in which a blunt steel borer was caused to revolve by horse-power. The cylinder was surrounded by a casing, in which was placed about 2½ gallons of water. When the borer was caused to revolve, the temperature of the water gradually rose, until, in two hours and a half, the whole quantity of water commenced to boil—a conclusive proof of the unlimited production of heat by mechanical means. A few years later, Sir Humphry Davy conclusively proved the immateriality of heat, by demonstrating the liquefaction of two pieces of ice submitted to friction in a freezing atmosphere. Now, it was admitted—even by the materialists, who contested every inch of ground—that water possesses more heat than ice at the same temperature, hence, if their explanation were valid, ice ought not to liquefy when submitted to friction in a freezing atmosphere.

Although the fallacy of the material theory was thus proved early in the century, the theory was by no means abandoned, and it continued to be generally adopted (when *any* theory at all of heat was adopted), until it was shown that a definite relationship exists between heat and mechanical work, and that they are mutually convertible. This determination of the so-called *mechanical equivalent of heat* was made almost simultaneously by Dr. Julius Mayer, of Heilbronn, in Wurtemburg, and by Mr. Joule, of Manchester, in the

* Some time ago a correspondent enquired in this journal if iron could really be hammered until it becomes red-hot, and some discussion was elicited on the subject, the general conclusion appearing to be that it is one of the many things which are much talked of, but never seen. I recently asked a blacksmith if he could do it, and he replied that he had never seen it done, but would try. In the first place a piece of very tough iron was hammered with a moderately heavy hammer; it became hot, but scarcely sufficiently so to scorch a piece of paper upon which it was placed. It was then hammered by two men, one of whom used a sledge hammer, but the iron scarcely became hotter than before. Presently a man who was working in the shop said he had often lit his forge fire by the means when matches were less plentiful than now, and he accordingly took a nail, such as is used for shoeing horses, and after hammering with a light hammer for less than two minutes, part of the nail was brought to a bright red heat. It thus appears that there is a good deal of knack in the operation; the blows were light but frequent, and the nail was turned at each blow, with something of the alternating motion which is adopted in feathering an oar; that is, if we suppose the nail to be square, it was turned, so as to receive one blow upon a surface A, the second on a contiguous side B, the third on A again, and so on, these two surfaces being struck alternately. A few months ago I say a heavily laden omnibus rapidly descending Pentonville-hill with a locked wheel; before reaching the bottom of the hill the bearing surface of the locked wheel was glowing with a bright red heat, and the adjacent woodwork was on fire.

year 1842. Mayer worked out his result rather by reasoning upon known facts than by direct experiment, while Joule instituted a lengthy and elaborate series of experiments, which were published in their entirety in 1850. Since this date, the kinetic theory of heat has been largely developed by the labours of Hirn, Helmholtz, and Sir William Thomson, and notably by Professor Clausius, of Zurich.

Let us now turn our attention to Joule's determination of the relationship existing between heat and mechanical work, or, more correctly, and in accordance with the definition of heat with which we started, of the amount of mass motion equivalent to and convertible into a definite amount of molecular motion. In this country, the unit of mechanical work (known as the *foot-pound*) is the mechanical force necessary to lift 1 lb. to a height of 1 foot *in vacuo*, and the unit of heat is the quantity of heat necessary to raise 1 lb. of water 1° F. in temperature strictly from 55° to 56° F. On the Continent, the unit of work (called a *kilogrammetre*) is the mechanical force necessary to lift 1 kilogramme to a height of 1 metre *in vacuo*, and the unit of heat is the quantity of heat necessary to raise 1 kilogramme of water from 0° C. to 1° C. Sometimes the quantity of heat necessary to raise 1 lb. of water from 0° to 1° C. is adopted as a unit of heat in this country.

Now the simplest and most definite form of mechanical force is the falling of a known weight through a known space under the influence of the force of gravity; and this form of force was employed by Mr. Joule to produce heat by friction. A falling weight was caused to communicate rotary motion to a paddle working respectively in water and in mercury, and to produce the revolution of cast-iron discs in contact; and the increase of temperature resulting from the friction was measured by thermometers which could be read to 1-200 of a degree Fahrenheit. The rise of temperature for each experiment was—in the case of water, 0·563° F.; mercury, 2·41° F.; and cast-iron, 4·3° F.* By this method, Joule ascertained that a weight of 1 lb., falling from a height of 772 feet, produces, on its collision with the earth, an amount of heat competent to raise the temperature of 1 lb. of water 1° F. (that is to say, to generate one unit of heat). Mayer, by a perfectly distinct method, found the number to be 771·4 feet—a difference of less than 0·1 per cent; hence there can be no doubt concerning the accuracy of the determinations.

Let us next consider the various modes by which heat may be generated—the various causes which tend to produce a rapid motion in the molecules of matter; and this brings us at once to the subject of *energy*.

Energy (ἐνέργεια, action, operation) is a term used in physics to designate the power of doing work against or overcoming the action of force, whether it be— (α) the attraction of masses acting through a sensible space (*gravity*); (β) the attraction of similar molecules acting through an insensible space (*cohesion*); (γ) the attraction of dissimilar molecules acting through an insensible space (*chemical affinity*); (δ) the attraction of molecules in different electrical or magnetic conditions (*electrical and magnetic attraction*), or any action whatsoever which it may be possible to resist. In fact, we may attach to the term energy almost the same meaning as it possesses when applied to ourselves. Energy is competent to exist in two conditions; viz., as *potential energy*, or possible energy; and as *kinetic energy*, or actual energy; and these may be likened to energy of character, and to energy of action in ourselves.

Potential energy, or energy of position, or possible energy, or, as Helmholz calls it, energy of tension, is energy existing in possibility, not in act, as in the case of a ball suspended above the surface of the earth, or an arrow resting upon a tense bow-string.

Kinetic energy, or energy of motion, or dynamic energy, or *vis viva*, or mechanical energy (for by these various names you will find it designated in different books), is the actual energy of a body in motion; as in the case of a ball falling to the earth's surface, or an arrow projected from a released bow-string.

Now, when the kinetic energy of a mass is suddenly arrested—as by collision with a larger mass—it is transformed into the motion of molecules—it becomes heat; and it has been found that the heat thus produced is dependent upon the mass of the moving body multiplied by the square of its velocity, that is, $h=mv^2$. From this, it follows that, if the velocity of a projectile be doubled, the heat developed on the stoppage of its motion will be increased fourfold; if trebled, ninefold; if quadrupled, sixteenfold; and so on. It has thus been calculated that a rifle-bullet, moving with a velocity of 1338 feet per second, develops, upon striking the target, sufficient heat to raise its temperature 1080° F., an amount more than sufficient to fuse it; but we must remember that this heat is shared between the bullet and the target. But, in the application of this law, we may pass from the arrested motion of a rifle-bullet to that of far larger masses of matter. Mayer and Helmholtz have calculated the amount of heat which would be produced by the stoppage of the earth in its orbit, and have determined that it would be sufficient not alone to fuse, but actually to vaporise the earth. The heat thus generated would be equal to that produced by the burning of fourteen spheres of coal, each equal to the earth in magnitude.

The amount of energy in the Universe is constant; we can neither add to it nor take from it; the only possible change is from one form to another; and this is called the principle of the *conservation of energy*.

Potential energy is constantly being converted into kinetic energy, and kinetic energy as constantly into heat. Friction, percussion, and compression, and the partial or complete stoppage of motion in any form, and by any means whatsoever, afford examples of this. (I.)—*By Friction.*—Lucretius tells us that fire was first made known to mortals, either by clouds meeting violently in collision and dashing out sparks of fire, or by the excessive friction of the branches of trees in a forest, induced by high winds, and resulting in fire. Friction has, from the earliest ages, been employed as a means of producing fire, and in our modern matches, although the labour is lessened, we still adopt the means. (The many experiments which illustrate this part of the subject are too well known to need detail here. Phosphorus may be readily ignited by the heat of friction (α) of a pointed piece of wood rubbed in a wooden groove; (β) of a gimlet which has been used for boring wood, or (γ) of a saw which has been used for sawing; (δ) by the heat resulting from the friction of the crystalline fibres of tin, by bending a rod of that metal repeatedly in opposite directions; and a number of examples will

* If water be violently shaken in a bottle for less than a minute, a rise of temperature of from 0·7° to 0·8° F. ensues; and in the case of mercury, of from 1·3° to 1·5° F. Of course, in both cases, if the bottles are shaken by the hand, they must be surrounded by several layers of thick flannel, to prevent any communication of heat from the hand. Mr. Herschell has ingeniously shown the heating of mercury by agitation by communicating rapid reciprocal motion to a tube containing a *small quantity of that metal, and then placing* a piece of phosphorus *on its surface: immediate ignition is the result.*

suggest themselves at once without further mention.) (II.)—*By Percussion.*—A piece of metal when hammered becomes hot, and may readily be brought to a red heat. When a pistol is cocked, potential energy is conferred upon the hammer; it is comparable to a raised weight: when the trigger is pulled, the potential energy becomes kinetic; when the hammer strikes the cap the kinetic energy becomes heat equal to that expended in raising the hammer. (III.)—*By Compression.*—A piece of wood, compressed in an hydraulic press, becomes warmer than before. In the rolling of the metals (as at the Mint), the bar, before passing between the rollers, is cold, but, after compression, it comes out so intensely heated that water assumes the spheroidal condition when poured upon it. (IV.)—*By Chemical Action.*—The production of heat by chemical action is probably due to the conversion of the kinetic energy of molecules into heat, as in the above instances, the heat resulted from the conversion of the kinetic energy of *masses*. (Instances of the production of heat by chemical action are too numerous to require notice here; take the combination of sulphuric anhydride with water, or of iodine with phosphorus, as examples.) Molecules, chemically separated, are in the condition of a raised weight, the energy which has been expended in separating them has overcome the force of chemical attraction, and removed the molecules out of its range; when they once again come within the range of the attraction, they rush together and unite chemically; their potential energy becomes kinetic, and the kinetic energy becomes heat. (V.)—*By Electricity in Motion.*—When kinetic electricity passes through a thin wire which offers some resistance to its passage, heat is copiously produced. (The production of heat by the energy of electricity in motion cannot be accounted for until we know more of the nature of electricity. Possibly, in the above experiment, the electricity so agitates the molecules of the conducting wire that, while transmitting its own motion, a collision of molecules results, and a consequent production of heat; or, in other words, the electricity may indirectly confer kinetic energy upon the molecules of the conducting wire, which energy is resolved into heat.)

The reverse of the above action also takes place. Heat is consumed—(α) in the production of mechanical work as in heat engines, the most prominent example of which is the steam-engine; (β) in the separation of molecules chemically united, as in any instance of decomposition by heat; and (γ) in the production of kinetic electricity, as in the thermo-electric pile. Mayer, writing in 1842, says: "A locomotive may be compared to a distilling apparatus; the heat applied under the boiler passes off as motion, and this is deposited as heat at the axles of the wheels."* Sparks may be frequently observed at the point of contact of the break-wheels and the rail at any of the "Metropolitan Railway" stations. The trains on this line keep up their speed until they are on the point of entering the station, hence their motion is more suddenly arrested than that of trains in general, and hence the above result. The loss of molecular motion (cold) which results from the performance of work, may be readily shown by causing a gas to perform work, as when the receiver of an air-pump is rapidly exhausted, the production of cold is shown by the deposit of moisture upon the sides of the receiver; it may also be readily shown by a Breguet's helix; or, again, when a cork is projected from a soda-water bottle, cold results. The condition of the cork at any moment can be clearly defined by bearing in mind that which has been said above on the subject of energy. At the outset the cork is in a condition of potential energy, for it has a greater pressure upon its under than its upper surface, and is hence competent to do work against gravity; when the string is cut, the potential energy becomes kinetic, and the cork is projected into the air. At any moment of its flight before attaining the final altitude, it possesses both potential and kinetic energy, for it possesses potential energy capable of causing it to fall through the space intervening between it and the earth, *plus* the kinetic energy which will raise it to the final altitude; when the latter is attained, the energy is obviously all potential, and the potential energy is not entirely transformed into kinetic until the cork reaches the earth; on its collision, heat is produced equal to that consumed in projecting it from the bottle.

* "On the Forces of Inorganic Nature." These essays were translated a few years ago, and were published in the *Philosophical Magazine*.

II. (ABSTRACT).

In this lecture, some of the effects of heat upon matter were discussed, commencing with expansion, and the experiments which illustrate this part of the subject were shown (such as the unequal of a compound bar, S'Gravesande's ball, and the various appliances by which liquids and gases can be shown to expand, as the alcohol and mercury thermometer, Galileo's air thermometer, Leslie's differential air thermometer, and so on). The intensity of the attractive force exerted by similar molecules acting through an insensible space (cohesion) was shown by the breaking of a bar of iron by the contraction of a metal bar during cooling.

The following definitions are taken for the most part from the lecture notes:—

"*Æstus est commotio . . . omnis commotio fervorem gignit.*" Heat having been defined in the last lecture as a motion of the small particles, or molecules of matter, it is obvious that the addition of this motion to a congeries of molecules must cause them to occupy a greater space (*expansion*); while the subtraction of this motion must cause them to occupy a less space than before (*contraction*).

In virtue of this, heat determines the form which matter assumes. In solids, the attraction of the molecules for each other (sometimes called *cohesion*, from *cohæreo*, to stick together), greatly predominates over the molecular motion, and, by limiting the range of movement, keeps them comparatively close together. In liquids, there is a greater amount of molecular motion; hence the range of movement of the molecules is extended; the cohesive force is lessened by the distance, and the molecules have a less restrained motion. In gases, there is a still greater amount of molecular motion: the molecules move at such a distance from each other that their individual attraction becomes a vanishing force; hence they are absolutely unrestrained in their motion. Thus, in the passage from solidity to gaseity, there is a progressive decrease of cohesive force, arising from a progressive augmentation of the space between the attracting molecules, and a progressive increase of molecular motion, arising from direct addition; while in the passage from gaseity to solidity, there is a progressive increase of cohesive force, arising from the diminution of the space between the attracting molecules, and a progressive decrease of molecular motion, arising from direct transference.

An increase of external pressure will obviously tend

to approximate the molecules of matter; and hence, *à priori*, will, to some extent, produce the same result as a subtraction of molecular motion; while a decrease of external pressure will afford the molecules a greater range of movement, and will hence produce the same result as an addition of molecular motion. Thus certain gases are liquefied by increasing the pressure (for example, chlorine and sulphurous anhydride), and certain liquids are gasefied by the removal of the existing pressure (for example, ethers having low boiling points, and, *à priori*, the liquids of gases liquefied by pressure).

We do not know the nature of the motion which constitutes heat. According to an hypothesis, which is ably supported, the molecules of solids and liquids move circularly around a centre, while the molecules of gases move in right lines. Thus a solid becomes liquid, in the language of this hypothesis, when the amplitude of the oscillation of its molecules passes a certain limit; and a liquid becomes a gas when its molecules fly off at a tangent to the circles in which they previously moved. This hypothesis is eminently Cartesian in its tone and character. (Examples of the passage of circular into tangential motion may be frequently observed—notably in the water which is projected from a trundled mop, in the sparks which fly off from a Catherine wheel, in the mud projected from the periphery of a rapidly-moving carriage wheel, and in a stone hurled from a sling. This last example is frequently adduced by Descartes (see his *Principia Philosophiæ*, pars. 2, cap. 39, entitled, "Altera lex naturæ, quod omnis motus ex se ipso sit rectus, et ideo quæ circulariter moventur, tendere semper ut recedant a centro circuli quem describunt;" and again, pars. 3, cap. 57 and 58). As a lecture experiment, it may be shown by attaching a small wooden ball to a spring (a helix of brass wire answers the purpose well), and communicating circular motion by whirling it in a vertical plane, either by the hand, or by a whirling table. As the velocity of revolution increases (analogous to the increased molecular motion induced by heating), the ball recedes from the centre of revolution (analogous to the act of expansion), until, at a certain maximum of rapidity, the ball may be released, or may be caused to break the spring, when it of course assumes a rectilinear motion (analogous to the passage of a liquid into the gaseous condition); or the helix of brass wire may be replaced by a piece of india-rubber tubing, to one end of which the ball may be fastened by a movable pin, worked by a string, which passes through the axis of the tube and is held by the hand. The revolution is commenced, and, when at its maximum, the string is pulled so as to dislodge the pin, and thus release the ball, which immediately changes its circular for tangential movement; or, again, rapid circular motion may be communicated to a very shallow bowl containing water, and the velocity augmented until the particles of water fly off tangentially.

Heat is usually measured by the expansion of a liquid or gas, it having been found that equal additions of molecular motion produce, (α) in the case of gases, equal alterations in bulk, irrespective of the nature of the gas; (β) in the case of liquids, nearly equal alterations in bulk in the same liquid, although different alterations in different liquids. (*Thermometry*, θερμος, heat; μετρον, a measure.)

A *degree of heat* is an arbitrary quantity, and it may be defined as the amount of molecular motion which is competent to increase the bulk of a certain quantity of specified matter to a certain known extent. A *unit of heat* was defined in the last lecture.

The *co-efficient of expansion* of a substance is the increase in length (*linear co-efficient*) or in bulk, (*cubical co-efficient*), produced by the assumption of a certain amount of molecular motion, by a substance whose length or bulk was known when it possessed a certain less amount of molecular motion, in both cases measured as described above. Thus, if the length of a brass rod at the freezing point of water (32° F.) be taken as 1·000000, its length at the temperature of boiling water (212° F.) will be found to be 1·001867, and the linear co-efficient of expansion of brass for 212°—32° F.=180° F. is hence 0·001867, and for 1° F.=$\frac{0{\cdot}001867}{180}$=0·00001038.

Evaporation (*evaporo*, to disperse in vapour), is the conversion of a liquid into gas at its exposed surface. The molecules at the surface, unlike those in the mass of the liquid, are influenced and restrained by the proximity of other molecules, *in one direction only*; hence, in the language of the hypothesis mentioned above, they more readily assume the rectilinear motion appertaining to the molecules of a gas.

Ebullition, or boiling (*ebullio*, to boil or bubble up), is the conversion of a liquid into gas by the assumption of rectilinear motion by the molecules in the interior of the liquid mass. The liquid continues to receive molecular motion until the cohesion of its molecules (plus or minus any of the extraneous actions mentioned below) is overcome; the molecules thus freed from restraint, part company with the liquid in the form of bubbles of gas. The temperature at which this takes place, subject to the conditions which at that time prevail, is called the *boiling point* of the liquid under those conditions.

The boiling point of a liquid is influenced by the following extraneous causes:—(α), external pressure, which, by limiting the motion of the molecules, and thus assisting cohesion, raises the boiling point; (β), the substance of the containing vessel, between which and the liquid molecules a certain attraction, differing for different substances, exist, which consequently assists cohesion, and raises the boiling point; (γ), dissolved substances, which in the case of dissolved solids tend to raise the boiling point, and in the case of dissolved air, to lower it. Thus water boils—(α) at a lower temperature on the summit of a mountain than at its base; (β) at a higher temperature in a glass than in a metal vessel; (γ) at a higher temperature when it contains salt in solution, as in sea water, than when it is free from dissolved solids, as in rain water; and at a far higher temperature when it is freed from dissolved air than when it contains air in solution.

Evaporation in the spheroidal condition is the surface evaporation of a liquid spheroid, floating upon a layer of its own gas, which separates it from direct contact with a surface possessing a higher (usually, but not necessarily, a much higher) temperature.

The spheroid has been proved to be out of contact with the hot surface by various means; thus the light of a flame can be seen through the space intervening between the spheroid and the hot surface, and nitric acid in the spheroidal condition upon a hot plate of copper does not attack it; neither does dilute sulphuric acid act upon zinc under the same conditions. We have analogous actions in the reverse experiment, in which a hot metal is caused to float upon a liquid surface, buoyed up by the layer of gas beneath. Thus, if a light silver ball be heated to whiteness, it will readily float upon the surface of water; and when iron is burned in

oxygen, the globules of molten oxide will frequently float for a second or two upon the surface of the water beneath, or sometimes they will fall through a layer of one or two inches of water, and yet be sufficiently hot when they reach the bottom to fuse themselves into the glass or earthenware tray. Again, the freezing of water and mercury in red-hot vessels is due to the same action: liquid sulphurous acid evaporates comparatively slowly upon a white-hot surface, and when a mixture of solid carbonic acid and ether is poured into a red-hot platinum crucible, it immediately assumes the spheroidal condition, evaporates comparatively slowly, and will readily freeze mercury.

III. (Abstract).

This lecture was chiefly devoted to a consideration of the effects produced by heat within a mass of matter, and the various forms of action which it then assumes. The following definitions, which are taken from the "Notes," convey the principal points of the lecture.

The attractive force existing between the molecules of matter, like all other attractive forces, decreases in intensity as the distance between the attracting molecules increases, and *vice versâ*. Liquids become solids (*solidification*) when they lose so much of their molecular motion that the molecules approach sufficiently near to each other to produce the effects of rigidity, in place of the former molecular mobility. (α). When the resulting solid assumes a definite geometrical form (*crystallisation*), the attractive force of its molecules probably varies in intensity in different directions; thus, supposing the molecules to be spherical, the attractive force would be greater or less in the direction of a diameter A than in the direction of a diameter B, cutting A at right angles; or, supposing the molecules to be ellipsoidal, the attractive force would be greater or less in the direction of the major axis than in the direction of the minor axis. (β). When the resulting solid does not assume a crystalline structure or form, the attractive force of the molecules probably does not vary in different directions, or the varying intensity may be equalised by extraneous causes (*amorphous solidification*).

When molecular motion is communicated to a substance, it is obvious that, before it can expand that substance, it must overcome the mutual attraction of its molecules at the particular distance at which they then exist; for expansion is the act of increasing the distance between individual molecules (*vide* Lecture II.). In thus separating the molecules, there is, consequently, a certain amount of work to be done (*the internal work of a mass of matter*), just as the separation of two masses—for instance, the raising of a weight to a height above the surface of the earth—involves the expenditure of an amount of work equal to the force of gravity which has been overcome, and, in both cases alike, heat is consumed in the performance of the work done. And as when a weight is raised above the surface of the earth it possesses potential energy (*vide* Lecture I.) competent, when converted into kinetic energy, to cause it to fall through the space which separates it from the earth, and to generate the heat consumed in raising it when its kinetic energy is arrested, so, likewise, the molecules of a substance expanded by heat possess potential energy (*molecular potential energy*) competent to cause them to recross the space through which they have been separated by the added molecular motion, and to generate the heat consumed in separating them when the kinetic energy thus induced is arrested.

And since all matter possesses a certain amount of molecular motion, and no two molecules are in contact, it follows that all molecules possess a certain amount of potential energy, and that the acts of heating and cooling (addition and subtraction of molecular motion) may be expressed respectively as the increasing and the lessening of molecular potential energy, considered in regard to its amount at the time of such addition or subtraction. (The first part of this assertion may be otherwise expressed by saying that nothing is so cold that it cannot be made colder; ice may be called excessively hot when compared with solid carbonic anhydride; in a word, the former possesses a far larger amount of molecular motion than the latter. The *absolute zero of temperature* is believed to be —273° C., and we must imagine that the molecules of matter would be in contact at this temperature. Matter thus constituted would be perfectly lifeless and inert; it would possess no motion, neither could its molecules transmit any motion. We have not yet succeeded in producing a degree of cold approaching the absolute zero. The rapid evaporation of liquid ammonia *in vacuo* in the presence of sulphuric acid produces a temperature of 87° C. below zero; liquid nitrous oxide, in becoming gas, reduces the temperature to —88° C.; solid carbonic acid produces a temperature of —90° C., and when mixed with ether and placed *in vacuo*, of —100° C., while the greatest artificial cold has been obtained by the rapid evaporation *in vacuo* of a mixture of liquid nitrous oxide with disulphide of carbon, when the temperature fell to —140° C. By the employment of a freezing mixture of solid carbonic anhydride and ether, simultaneously with excessively high pressures, Andrews has reduced nitric oxide to 1-680th of its original volume, oxygen to 1-554th, and hydrogen to 1-500th, but in no instance did these gases exhibit signs of liquefaction. It is obvious that in the case of compressible matter pressure will tend equally with loss of molecular motion to lessen the molecular potential energy.)

From the above paragraphs it follows that, when molecular motion is added to molecules, it performs two functions, for a portion of it is converted into work (*vide* Lecture I.) which confers potential energy upon the molecules by separating them (*expansion*), while another portion increases the temperature of the substance (*vide* Lecture II.), by conferring upon the molecules a larger quantity of the motion which constitutes heat, and hence increasing their velocity. Thus a portion of the added molecular motion disappears as heat, and this is still known as *Latent Heat*—(*Lateo*, to lie hid, because it was imagined by those who adopted the material theory of heat (*vide* Lecture I.) that the heat thus designated was somehow hidden in the substance, as in a cave, and that it only came out under certain conditions, and this idea was one of the most notable of the many *idola specus* possessed by the Materialists).

The quantity of heat which is thus expended in interior work when a solid passes into a liquid, or a liquid into the gaseous condition, can be readily determined. Thus, if a pound of boiling water (212° F.) be mixed with a pound of ice-cold water (32° F.) the temperature of the resulting two pounds of water is found to be 122° F., that is, the mean of the two:— $\frac{212° + 32°}{2}$ F. = 122° F. But if a pound of ice (32° F.) be mixed with a pound of boiling water, the temperature of the resulting two pounds of water is found to be only 51° F. Now it is obvious that the difference in the total heat

of the two mixtures is that required to raise two pounds of water, 122° — 51° F. = 71° F., or one pound through 142° F. In other words, in the act of liquefying a pound of ice at 32° F., an amount of heat is consumed as internal work which is competent to raise one pound of water through 142° F.; that is to say, 142 units of heat (*vide* Lecture I.), which represents as mechanical work one pound weight raised to a height of 772×142 feet = 109,924 feet (or more than 20 miles) above the surface of the earth (*vide* Lecture I.).

The actual amount of molecular motion possessed by different substances (*specific heat*) varies considerably, for not only do the molecules in a given space vary in quantity, but also in weight, and in their attraction for each other; hence, also, the amount of heat consumed in internal work varies, because it depends upon the relative attraction of the molecules.

The amount of molecular motion necessary to raise any substance through a known number of thermometric degrees (*vide* Lecture II.) compared with that necessary to raise the same weight of water through the same number of degrees, is called the specific heat of that substance. Thus, to raise 1 lb. of water 1° F. in temperature requires thirty-three times the amount of heat necessary to rise one pound of mercury 1° F. in temperature; hence, the specify heat of water being represented by 1·00, that of mercury will be 0·033.

Conduction of Heat is the transference of molecular motion from molecules possessing a certain amount of it to molecules possessing less of it, by direct communication of motion. Those molecules which are apt to receive and transmit the motion are called *conductors* of heat, while those which are unfitted for the reception and transmission of the motion (whether from their slight mobility, or from an inaptitude to accommodate themselves to that kind of motion) are called *non-conductors* of heat.

Convection (from *conveho*, to carry up) is an action induced by external means—the force of gravity—in virtue of which a congeries of molecules of liquid or gas, possessing a greater amount of molecular motion than surrounding congeries or system of congeries, rises *en masse*, because the motion of heat, by increasing the distance between the molecules of matter (*vide* Lecture II.) causes a given number thereof to occupy a larger space when they possess a certain amount of that motion than when they possess relatively less, whence ensues a difference of density and a consequent difference of action on the part of gravity, for in equal bulks there are now no longer equal weights of matter, and one mass is now attracted by the earth more powerfully than the other.

ADDITIONAL OBSERVATIONS ON HYDROGENIUM.*

BY THOMAS GRAHAM, F.R.S.,

MASTER OF THE MINT.

From the elongation of a palladium wire, caused by the occlusion of hydrogen, the density of hydrogenium was inferred to be a little under 2. But it is now to be remarked that another number of half that amount may be deduced with equal probability from the same experimental data. This double result is a consequence of the singular permanent shortening of the palladium wire observed after the expulsion of hydrogen. In a particular observation formerly described, for instance, a wire of 609·14 m.m. increased in length to 618·92 m.m when charged with hydrogen, and fell to 599·44 m.m. when the hydrogen was extracted. The elongation was 9·77 m.m., and the absolute shortening or retraction 9·7 m.m., making the extreme difference in length amount to 19·47 m.m. The elongation and retraction would appear, indeed, to be equal. Now it is by no means impossible that the volume added to the wire by the hydrogenium is represented by the elongation and retraction taken together, and not by the elongation alone, as hitherto assumed. It is only necessary to suppose that the retraction of the palladium molecules takes place the moment the hydrogenium is first absorbed, instead of being deferred till the latter is expelled; for the righting of the particles of the palladium wire (which are in a state of excessive tension in the direction of the length of the wire) may as well take place in the act of the absorption of the hydrogenium as in the expulsion of that element. It may, indeed, appear most probable in the abstract that the mobility of the palladium particle is determined by the first entrance of the hydrogenium. The hydrogenium will then be assumed to occupy double the space previously allotted to it, and the density of the metal will be reduced to one-half of the former estimate. In the experiment referred to, the volume of hydrogenium in the alloy will rise from 4·68 per cent to 9·36 per cent, and the density of hydrogenium will fall from 1·708 to 0·854, according to the new calculation. In a series of four observations upon the same wire, previously recorded, the whole retractions rather exceeded the whole elongations, the first amounting to 23·99 m.m., and the last to 21·38 m.m. Their united amount would justify a still greater reduction in the density of hydrogenium, namely to 0·8051.

The first experiment, however, in hydrogenating any palladium wire appears to be the most uniform in its results. The expulsion of the hydrogen afterwards by heat always injures the structure of the wire more or less, and probably affects the regularity of the expansion afterwards in different directions. The equality of the expansion and the retraction in a first experiment appears, also, to be a matter of certainty. This is a curious molecular fact, of which we are unable as yet to see the full import. In illustration, another experiment upon a pure palladium wire may be detailed. This wire, which was new, took up a full charge of hydrogen, namely, 956·3 volumes, and increased in length from 609·585 to 619·354 m.m. The elongation was, therefore, 9·769 m.m. With the expulsion of the hydrogen afterwards, the wire was permanently shortened to 600·115 m.m. It thus fell 9·470 m.m. below its normal or first length. The elongation and retraction are here within 0·3 m.m. of equality. The two charges taken together amount to 19·239 m.m., and their sum represents the increase of the wire in length due to the addition of hydrogenium. It represents a linear expansion of 3·205 on 100, with a cubic expansion of 9·827 on 100. The composition of the wire comes to be represented as being—

	In volume.	
Palladium	100·000	or 90·895
Hydrogenium.....	9·827	or 9·105
	109·827	or 100·000

The specific gravity of the palladium was 12·3, the weight of the wire 1·554 grm., and its volume 0·126 cub. centim. The occluded hydrogen measured 120·5

* Read before the Royal Society, June, 1869.

cub. centims. The weight of the same would be 0·0108 grm., and the volume of the hydrogenium 0·012382 cub. centim. (100 : 9·827 :: 0.126 : 0·01238). The density of the hydrogenium is therefore

$$\frac{0{\cdot}0108}{0{\cdot}01238} = 0{\cdot}872.$$

This is a near approach to the preceding result, 0·854. Calculated on the old method, the last experiment would give a density of 1·758.

It was incidentally observed, on a former occasion, that palladium alloyed with silver continues to occlude hydrogen. This property is now found to belong generally to palladium alloys, when the second metal does not much exceed one-half of the mixture. These alloys are all enlarged in dimensions when they acquire hydrogenium. It was interesting to perceive that the expansion was greater than happens to pure palladium, about twice as much; and that, on afterwards expelling the hydrogen by heat, the fixed alloy returned to its original length *without any further shortening of the wire*. The embarrassing retraction of the palladium has, in fact, disappeared.

The fusion of the alloys employed was kindly effected for me by Messrs. Mattey and Sellon, when the proportion of palladium was considerable, by the instrumentality of M. Deville's gas furnace, in which coal gas is burned with pure oxygen; or by means of a coke furnace, when the metals yielded to a moderate temperature. The alloy was always drawn out into wire if possible, but if not sufficiently ductile, it was extended by rolling into a form of a thin ribbon. The elongation caused by the addition of hydrogenium was ascertained by measuring the wire or ribbon stretched over a graduated scale, as in the former experiments.

1. *Palladium, Platinum, and Hydrogenium.*—Palladium was fused with platinum, a metal of its own class, and gave an alloy consisting, according to analysis, of 76·03 parts of the former, and 23·97 parts of the latter. This alloy was very malleable and ductile. Its specific gravity was 12·64. Like pure palladium, it absorbed hydrogen, evolved on its surface in the acid fluid of the galvanometer, with great avidity.

A wire 601·845 m.m. in length (23·69 inches) was increased to 618·288 m.m., on occluding 701·9 volumes of hydrogen gas measured at 0° C. and 0·76 barom. This is a linear elongation of 16·443 m.m. (0·6472 inch), or 2·732 on a length of 100. It corresponds with a cubic expansion of 8·423 volumes on 100 volumes; and the product may be represented—

	In volume.
Fixed metals	100·000 or 92·225
Hydrogenium	8·423 or 7·775
	108·423 or 100·000

The elements for the calculation of the density of hydrogenium are the following, the assumption being made as formerly, that the metals are united without condensation :—

Original weight of the wire, 4·722 grms.
Original volume of the wire, 0·373 cub. centim.
Volume of the hydrogen extracted, 264·5 cub. centims.
Weight of the hydrogen extracted, by calculation, 0·0237 grm.

The volume of the hydrogenium will be to the volume of the wire (0·373 cub. centim.) as 100 is to 8·423; that is, 0·03141 cub. centim. Finally, dividing the weight of the hydrogenium by its bulk, 0·0237 by 0·03141, the density of hydrogenium is found to be 0·7545.

On expelling all hydrogen from the wire at a red heat, the latter returned to its first dimensions as exactly as could be measured. The platinum present appears to sustain the palladium, so that no retraction of that metal is allowed to take place. This alloy therefore displays the true increase of volume following the acquisition of hydrogenium, without the singular complication of the retraction of the fixed metal. It now appears clear that the retraction of pure palladium must occur on the first entrance of hydrogen into the metal. The elongation of the wire due to the hydrogenium is negatived thereby to the extent of about one-half, and the apparent bulk of the hydrogenium is reduced to the same extent. Hydrogenium came in consequence to be represented of double its true density.

The compound alloy returns to its original density (12·64) upon the expulsion of the hydrogen, showing that hydrogen leaves without producing porosity in the metal. No absorptive power for vapours, like that of charcoal, was acquired.

The same wire of palladium and platinum, charged a second time with hydrogen, underwent an increase in length from 601·845 to 618·2, or sensibly the same as before. The gas measured 258 c.c., or 619·6 times the volume of the wire. The product may be represented as consisting of—

	By volume.
Fixed metals	92·272
Hydrogenium	7·728
	100·000

The density of hydrogenium deducible from this experiment is 0·7401. The mean of the two experiments is 0·7473.

2. *Palladium, Gold, and Hydrogenium.*—Palladium used with gold formed a malleable alloy, consisting of 75·21 parts of the former and 24·79 parts of the latter, of a white colour, which could be drawn into wire. Its specific gravity was 13·1. Of this wire 601·85 m.m. occluded 465·2 volumes of hydrogen, with an increase in length of 11·5 m.m. This is a linear elongation of 1·91 on 100, and a cubic expansion of 5·84 on 100. The resulting composition was therefore as follows :—

	In volume.	
Alloy of palladium and gold	100·00 or	94·48
Hydrogenium	5·84 or	5·52
	105·74	100·00

The weight of the wire was 5·334 grms.
The volume of the wire was 0·4071 c.c.
The volume of hydrogen extracted, 189 c.c.
The weight of the hydrogen, 0·01693 grm.
The volume of the hydrogenium, 0·02378 c.c.
Consequently the density of the hydrogenium is 0·711.

The wire returned to its original length after the extraction of the hydrogen, and there was no retraction.

The results of a second experiment on the same wire were almost identical with the preceding.

The elongation on 601·85 m.m. of wire was 13·3 m.m., with the occlusion of 463·7 volumes of hydrogen. This is a linear expansion of 1·902 on 100, and a cubic expansion of 5·81 on 100. The volume of hydrogen gas extracted was 188·8 c.c., of which the weight is 0·016916 grm. The volume of the hydrogenium was 0·02365 c.c., that of the palladium gold alloy being 0·4071 c.c. Hence the density of the hydrogenium is 0·715.

In a third experiment, made on a shor

[English Edition, Vol. XX., No. 502, page 17.]

the same wire, viz., 241·2 m.m., the amount of gas occluded was very similar, viz., 468 volumes, and was not increased by protracting the exposure of the wire for the long period of 20 hours. There can be little doubt, then, of the uniformity of the hydrogenium combination, the volume of gas occluded in the three experiments being 464·2, 463·7, and 468 volumes. The linear expansion was 1·9 on 100 in the third experiment, and therefore similar also to the preceding experiments.

The hydrogenium may be supposed to be in direct combination with the palladium only, as gold by itself shows no attraction for the former element. In the first experiment the hydrogenium is in the proportion of 0·3151 to 100 palladium and gold together. This gives 0·3939 hydrogenium to 100 palladium; while a whole equivalent of hydrogenium is 0·939 to 100 palladium.* The hydrogenium found is, by calculation, 0·4195 equivalent, or one equivalent hydrogenium to 2·383 equivalents palladium, which comes nearer to two equivalents of the former with five of the latter than to any other proportion.

To ascertain the smallest proportion of gold which prevents retraction, an alloy was made by fusing seven parts of that metal with 93 parts of palladium, which had a specific gravity of 13·05. The button was rolled into a thin strip and charged with hydrogen by the wet method. An occlusion of 585·44 volumes of gas took place, with a linear expansion of 1·7 on 100. A retraction followed to nearly the same extent on afterwards expelling the hydrogen by heat.

With another alloy, produced by fusing 10 of gold with 90 of palladium, the occlusion of gas was 475 volumes, the linear expansion 1 65 on 100. The retraction on expelling the gas afterwards was extremely slight. To nullify the retraction of the palladium, about 10 per cent of gold appears therefore to be required in the alloy.

Another alloy of palladium of sp. gr. 13·1, and containing 14·79 per cent of gold, underwent no retraction on losing hydrogen, as already stated.

The presence of so much gold in the alloy as half its weight did not materially reduce the occluding power of the palladium. Such an alloy was capable of holding 459·9 times its volume of hydrogen, with a linear expansion of 1·67 per cent.

3. *Palladium, Silver, and Hydrogenium.*—The occluding power of palladium appeared to be entirely lost when that metal was alloyed with much more than its own weight of any fixed metal. Palladium alloys containing 80, 75, and 70 per cent of silver occluded no hydrogen whatever.

With about 50 per cent of silver, palladium rolled into a thin strip occluded 400·6 volumes of hydrogen. It expanded 1·64 part in 100 in length, and returned to its original dimensions without retraction upon the expulsion of the gas. The specific gravity of this silver-palladium alloy was 11·8; the density of the hydrogenium 0·727.

An alloy, which was formed of 66 parts of palladium and 34 parts of silver, had the specific gravity 11·45. It was drawn into wire, and found to absorb 511·37 volumes of hydrogen. The length of the wire increased from 609·601 to 619·532 m.m. This is a linear elongation of 1·629 on 100, or cubic expansion of 4·97 on 100. The weight of the wire was 3·483 grms.; its volume 0·3041 c.c. The absolute volume of occluded hydrogen was 125·1 c.c., of which the weight is 0·01120896. The volume of the hydrogenium was 0·015105 c.c. The resulting density of hydrogenium is 0·742.

In a repetition of the experiment upon another portion of the same wire, 407·7 volumes of hydrogen were occluded, and the wire increased in length from 609·601 m.m. to 619·44 m.m. This is a linear expansion of 1·614 part on 100, and a cubic expansion of 4·92 on 100. The absolute volume of hydrogen gas occluded was 124·0 c.c., and its calculated weight 0·01111 grm. The volume of the hydrogenium being 0·1496 c.c., the density of hydrogenium indicated is 0·741. The two experiments are, indeed, almost identical. The wire returned in both experiments to its original length exactly after the extraction of the gas.

4. *Palladium, Nickel, and Hydrogenium.*—The alloy, consisting of equal parts of palladium and nickel, was white, hard, and readily extensible. Its specific gravity was 11·22. This alloy occluded 69·76 volumes of hydrogen, with a linear expansion of 0·2 per cent. It suffered no retraction below its normal length on the expulsion of the gas by heat.

An alloy of equal parts of *bismuth* and palladium was a brittle mass that did not admit of being rolled. It occluded no hydrogen, after exposure to that gas as the negative electrode, in an acid fluid for a period of 18 hours. It seems probable that malleability and the colloid character, which are wanting in this bismuth alloy, are essential to the occlusion of hydrogen by a palladium alloy.

An alloy of one part of *copper* and six parts of palladium proved moderately extensible, but absorbed no sensible amount of hydrogen. The metallic laminæ which remained on digesting this alloy in hydrochloric acid, and which were found by M. Debray to be a definite alloy of palladium and copper (PdCu), exhibited no sensible occluding power.

The conclusions suggested as to the density of hydrogenium, by the compound with palladium alone and by the compounds with palladium alloys, are as follows:—

	Density of Hydrogenium observed.
When united with palladium.....	0·8540 to 0·8720
When united with palladium and platinum	0·7401 to 0·7545
When united with palladium and gold....	0·7110 to 0·7150
When united with palladium and silver...	0·7270 to 0·7420

The results, it will be observed, are most uniform with the compound alloys, in which retraction is avoided, and they lie between 0·711 and 0·7545. It may be argued that hydrogenium is likely to be condensed somewhat in combination, and that consequently the smallest number (0·711) is likely to be the nearest to the truth. But the mean of the two extreme numbers will probably be admitted as a more legitimate deduction from the experiments on the compounds alloys, and 0·733 be accepted provisionally as the approximate density of hydrogenium.

I have the pleasure to repeat my acknowledgments to Mr. W. C. Roberts for his valuable assistance in this inquiry.

* H = 1; Pd = 106·5.

ON CRYSTALS INCLOSED IN BLOWPIPE BEADS.

BY H. C. SORBY, F.R.S., ETC.

At the *soirée* of the Royal Society on March 6, by the kind assistance of my friend Mr. Wm. Baker, I exhibited a number of blowpipe beads inclosing various crystals of such extreme beauty as mere microscopical

objects, that probably some account of them may be interesting, independently of their connection with chemistry and mineralogy.

It has long been known that blowpipe beads often become opaque on flaming; and Emerson* showed that, by proper manipulation, well-formed crystals can be produced in them, and recognised by their characteristic forms when magnified. Rose† described very interesting results thus obtained in the case of titanic acid; and Captain Ross has published several papers in the Chemical News,‡ in which he gives the results obtained by blowing out the beads into thin vesicles, exhibiting minute characteristic crystals. My method differs materially from those described by the above-named authors. I use borax as the solvent, and, if requisite, add various reagents to produce, as it were, precipitates of characteristic crystalline form. By keeping the supersaturated fused beads over the flame, crystals may be obtained in cases where, according to Emerson, nothing satisfactory results from mere flaming; and the addition of various reagents adds greatly to our resources in the cases of earths variously mixed or combined with mineral acids. It is not my intention to enter now into the purely chemical part of the subject, or to show its application to mineralogy. I shall merely give a short account of some specimens thus prepared, which may be of interest as microscopical objects of remarkable character. Many are good illustrations of the manner in which crystals grow up from the simple nuclei to complicated forms of extreme beauty; and it is very instructive to see how the definite secondary planes of the crystals, viewed as a whole, are produced by the regularly graduated growth of numerous small crystals symmetrically deposited. This is sometimes so striking as to lead me to hope that further study may throw important light on the cause of the production of secondary crystalline forms.

In preparing the specimens, so much of the substance must be added to the borax that it entirely dissolves at a high temperature, but is partially deposited when kept for some time at a heat below dull redness. The beads should be about ⅛ inch in diameter, and one-third that thickness. The loop in the platinum wire can easily be made circular by bending it round a glass rod. I need scarcely say that no one ought to expect to obtain good specimens at first. Much depends on that sort of manipulation which is easier to learn by experience than explain by writing.

The most useful object-glass is a 4-10 inch, of small aperture, made to adjust for looking through thick glass, so that crystals may be distinctly seen in the interior of the beads. When no condenser is used, the double convex form of the beads prevents our seeing more than a small portion of the interior; but by using as a condenser a plano-convex lens, of about ½ inch diameter and ½ inch focal length, nearly the whole bead is illuminated, without the definition being materially injured; and even this may be overcome by properly regulating the distance of the condenser, and the size of the aperture below it. The full beauty of the specimens can only be seen with a binocular microscope, and few objects are better fitted to show the advantage of that kind of instrument. The crystals then stand out in perfect relief, and are seen to be equally complicated in all directions. It must not be thought that in each case all the crystals are alike. Those formed on the surface differ much from those in the interior of the beads; and in both positions, though the type is constant, the forms vary very considerably.

After having obtained crystals of satisfactory character, if it be desirable to keep the specimen as a permanent object, the ring-shaped loop and inclosed bead should be cut off and mounted in a cell with Canada balsam. This is requisite, since the moisture of the atmosphere causes the borax to become hydrated and opaque; but, when properly mounted in balsam, it alters so slowly that I have not remarked any change for half a year. When thus mounted, the curved form of the beads almost ceases to be any impediment in examining crystals in the interior, and an ordinary achromatic condenser of long focal length may be used with advantage; but in some cases crystals on the surface are much less distinct than when the beads are not mounted.

Few objects of the kind are more easily prepared than the crystals of borate of magnesia deposited from borax saturated with magnesia. They first form as thin prisms, and smaller crystals are afterwards deposited, so as to give rise to objects very much like a handle with a brush at each end.

Zircon or zirconia fused with borax yields crystals of the borate. In their most rudimentary state they are small prisms with a simple cross at each end, which afterwards becomes complicated.

The crystals of molybdate of zirconia formed by fusing zirconia in borax with molybdic acid, are extremely elegant and beautiful objects. They are so delicate that their own weight would probably break them, if they were in an aqueous solution; but being supported in solid borax, like the insects inclosed in amber, they are secure from all injury.

Scheelite—native tungstate of lime—fused in borax is deposited in crystals of great beauty, and is an object easily prepared.

The molybdate of strontia, produced by fusing strontia and molybdic acid in borax, crystallises in long spindle-shaped crystals, whereas the molybdate of lime yields very different crystals, of a form intermediate between that of molybdate of zirconia and scheelite.

Apatite—native phosphate of lime—fused with borax, deposits in crystals which vary much in shape. Six-sided stars are often formed on the surface, and needle-shaped crystals grow from their centres into the interior of the borax, so that they look like nails with highly ornamental heads driven down into the bead. When formed with their axes parallel to the surface, the crystals are sometimes much like *diatomaceæ*. The addition of phosphate of soda to a borax bead containing lime in almost any state of combination gives rise to similar crystals.

On adding a certain amount of carbonate of soda to quartz or various silicates dissolved in borax, crystals are deposited, which vary much according to circumstances; but they all seem to be due to the variable growth of many small six-sided prisms with expanded ends. Sometimes they have a curious dice-box form, resulting from a bundle of such crystals. Probably such are some silicate of soda, modified by the presence of other bases.

Titanic acid gives hair-like prisms variously grouped. Molybdic acid is sometimes set free as liquid globules, which coalesce, rise to the surface, and afterwards solidify as small spheres.

* *Proceedings of the American Academy*, 1866, vol. vi., p. 476.
† *Berlin Acad. Bericht*, 1867, pp. 129, 450.
‡ Vol. xvi., p. 307 (*Am. Repr., Feb.* 1868, *page* 74); vol. xvii., pp. 35, 63, 82, 87, and 107 (*Am. Repr., March*, 1868, *page* 147; *April*, 1868, *pages* 157, 198, 196).

These few examples will, at all events, serve to show that the crystals deposited in blowpipe beads are of considerable interest, merely as beautiful microscopical objects. I should, however, be very sorry if any one were to imagine that I considered this their chief merit. On another occasion my aim will be to prove that this method may be employed with great advantage in determining the nature of minerals and chemical precipitates, when so small a quantity can be procured that other methods would almost or entirely fail to give satisfactory results.—*Monthly Microscopical Journal.*

ANALYSIS OF THE WATER.

OF THE

"ROYAL SULPHUR SPRING," HARROGATE.

BY SHERIDAN MUSPRATT, M.D. (HON.), F.R.S.ED., M.R.I.A., ETC.

The water of this new spring has recently been introduced into the Royal Pump Room at Harrogate Wells, and, as it may prove an efficient *intermediate* one (*i.e.*, not so *strong* as the "Old Sulphur Well," *vide* my analyses, Chemical News, vol. viii., p. 155 (*Eng. ed.*), and *stronger* than the "Magnesia Water," vol. viii., p. 195 (*Eng. ed.*), I forward the results for publication in your valuable journal. Its characteristics, on reaching me (it was in a large stone jar, well sealed), were the annexed:—

An opaque appearance, owing to a separation of sulphur; a strong smell (this it does not evolve when drawn from the pump) of sulphide of hydrogen, which, collaterally with the milky shade of the liquid, indicated oxidation and decomposition of the sodic sulphide (NaS). On immediately filtering the water, the filtrate was perfectly clear and bright. During the analysis, &c., I found that, on boiling the water by direct heat, and likewise by the agency of steam, 1·986 grains per gallon of the sulphur were eliminated as gas (sulphide of hydrogen), the remaining portion withstanding the effects of both kinds of caloric. The water was alkaline, due to the earthy carbonates. The sulphur calculated as gas (sulphide of hydrogen) constituted 11·80 cubic inches per gallon. By prolonged exposure to atmospheric influences, the *whole* of the sulphur in the water deposited. It gave no organic matter, and only mere indications of ammonia, &c. The occurrence of the salts of barium, strontium, lithium in all the spas of Harrogate is very remarkable, for these compounds did not, and could not, exist in them twelve years ago, when my distinguished collaborateur, Dr. Hofmann, investigated them. Sulphates have disappeared from all of them. I do not consider that the presence of the chlorides of barium and strontium in any way enhances their medicinal properties; for, as soon as the water is imbibed, the chlorides become sulphates.

There can be no question, I think, that the additional ingredients are derived from the strata in the vicinity of Pately Bridge, nine miles west of Harrogate. All the strong spas contain barium and strontium; the Dr. Muspratt Chalybeate "chloride of iron" (FeCl) also. A recent analysis of it gives 16 grains of this latter salt in the gallon; so the amount is just the same as it was when I discovered its presence in 1865. The efficacy of this ferruginous compound in a potable water is now beyond a doubt; it is more easily assimilated than any other ferrous salt: Dr. Myrtle remarks—"I could fill volumes with cases benefited or cured by its use."

College of Chemistry, Liverpool,
July 1st, 1869.

ON THE

EXAMINATION OF WATER FOR ORGANIC MATTER.*

BY R. ANGUS SMITH, PH.D., F.R.S., ETC.

(Continued from Am. Repr., August, 1869, page 80).

Use of Permanganate of Potash, or Chameleon.

It must be remembered that the amount of organic matter obtained in the above way by weighing and burning may be equal to several grains in a gallon, and yet be quite innocent; for example, it may be a little peaty matter. One method of trying the quality is given above; another, of a very convenient kind, is by the use of permanganate of potash, or mineral chameleon. It will here be called chameleon, as the former term is very long. It is very highly coloured, and its decomposition is known by the disappearance of the colour.

Chameleon is decomposed by putrid organic matter, and by several unwholesome gases, rapidly or instantaneously. It is decomposed by fresh organic matter, and especially organised matter, less rapidly. The putrid portion may be estimated readily; the latter is more uncertain.

In using this test, it is well to take not less than 5000 grains of the water, or, still better, 1000 grammes, *i.e.*, one litre; but if a small specimen only can be obtained, then as little as 1000 grains may be used; but it is well always to give the figures for 1000 for uniformity, or (by multiplying by 70) to change them into the amount per gallon; one million, however, is still better, and I propose to use it always for air and water. Grains or grammes may be used indifferently, the solution being made to contain simply so much in 1,000,000.

A convenient plan is to use 2 grains of the pure crystallised chameleon to 1000 of water. This, of course, is the same as 2 grammes to a litre of water.

The chameleon is poured conveniently from a Mohr's burette, or, better still, when the water is very pure, from a dropping-tube in which 1 c.c. is 6 to 8 inches long. Add a drop of the chameleon, and wait till the colour disappears; add another, and so on, till the colour remains permanent. The organic matter which decomposes the chameleon in a minute or two must be noted carefully; but generally there is a greater quantity which decomposes very slowly; the result obtained from the latter is, I believe, of less value. By decomposing in a minute or two, it is meant that when a few drops are added, producing a slight colour, this undergoes a change in a minute or two. But generally, considerable permanency is obtained in ten or fifteen minutes; then the slow decomposition begins of quite another quality of organic matter, requiring hours, or even days. This matter must be estimated either by the weighing process described, or by the further action of the chameleon, to be described. The amount decomposed instantly is a true measure of the putridity, it is believed. If there is very much organic matter, it

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester.* (Communicated with emendations and alterations by the author.)

is often very difficult to know when to stop, as the brown masks the red colour. But this must not bring discouragement, as experience will teach exactness; and, if it does not allow exactness, it then will be no great loss in such cases in a sanitary point of view, as in them there is decidedly too much organic matter, and the water may be condemned. From the same point of view, it is of less consequence whether the amount be a minute quantity more or less. It is well to make broad lines of distinction, and to condemn freely when there is rational hope of obtaining a purer water.

The amount of available oxygen in one of the solutions of chameleon described is 0·0005, which may be either grammes or grains, or almost exactly 1 of oxygen in 2000 of the solution. If we wish to know the amount of oxygen used, we simply divide the amount of chameleon by 2000. It is probable that the use of the oxygen column is the only exact method of recording the results; and it is probable that the amount of oxygen required is the only exact measure of the impurity of the substances. We obtain in this number the amount of oxygen which is required for purification.

Whilst looking over this plan in manuscript, I received Dr. Miller's paper, proposing also to use oxygen; he prefers a solution of chameleon containing 3·95 grains, equal to 1 grain of available oxygen to 10,000 of water, or 1 c.c.=0·001 gramme, or, say, 1 milligramme of oxygen. This is a very convenient method; but it has been thought proper to keep the tables as given for various reasons, chiefly arising from this—that it has not been found so convenient to keep or to titre a very weak solution. In some cases, a very strong solution is required; we can easily dilute it, but we cannot concentrate it readily. After estimating its strength, we dilute it (if we require a weak solution) to any amount we think proper; and as the strength changes, the amount of water to be added will also change. If the amount of oxygen is given as the result of the analysis instead of the amount of chameleon solution, the strength of the latter does not require to be kept uniform. The analyst requires only to know its strength at the time of using it. For very bad water, the strong solution may be used; and, when greater delicacy is wanted, it may be diluted. The weak solution here used is made by adding nine of water to one of the strong solution.

To make the chameleon solution, very pure water must be employed, and very pure crystals, as well as very pure vessels; it is better kept in considerable quantities, such as a quart or two. It must be tried occasionally, say every month, in a cool climate: calculation must be made as allowance for any change which it may undergo. If calculation is not agreeable, a less quantity of solution may be made at a time, and that which is over may be thrown away, a fresh amount being made to the normal strength whenever the original weakens; or a certain amount of the crystals may be weighed and added to the solution; but this has been found less convenient.

The estimation of the value of the chameleon is sometimes made with a solution of chloride of iron, sometimes oxalic acid. For ready reference, a table is made showing the amount of a solution of iron which corresponds to a certain amount of chameleon. The sulphate of ammonia and iron has proved to be very valuable. The writer has not found oxalic acid equally sharp and quick; but eminent chemists use it—Mohr and Miller, for example.

Values of the Strong Solution.

Permanganate of Potash or Chameleon 2 grammes in 1000 c.c.	Oxygen.	Ferrum.	$FeO,SO_3+NH_4O,SO_3+6Aq.$	KO,Mn_2O_7.
c.c.	gr.	gr.	gr.	gr.
1	0·000500	0·0035	0·0247	0·002
2	0·001000	0·0070	0·0494	0·004
3	0·001500	0·0106	0·0742	0·006
4	0·002000	0·0141	0·0989	0·008
5	0·002500	0·0176	0·1237	0·010
6	0·003000	0·0212	0·1484	0·012
7	0·003500	0·0247	0·1732	0·014
8	0·004000	0·0282	0·1979	0·016
9	0·004503	0·0318	0·2227	0·018
10	0·005000	0·03535	0·2474	0·020
100	0·050600	0·3535	2·4747	0·200
1000	0·506300	3·5353	24·7470	2·000

The numbers in the above table run in the following proportions nearly :—

Chameleon Solution.	Oxygen.	Iron.	Sulphate of Iron and Ammonia.	KO,Mn_2O_7 Crystals.
2000	1	7	49	4

It is convenient to use six figures of decimals, as they may also be read as whole numbers, meaning so much in a million.

Values of the Weak Solution.

Permanganate of Potash or Chameleon Solution. 0·2 gramme in 1000 c.c.	Oxygen.	Ferrum.	$FeO,SO_3+NH_4O,SO_3+6Aq.$	KO,Mn_2O_7.
c.c.	gr.	gr.	gr.	gr.
1	0·000050	0·00035	0·00247	0·0002
2	0·000100	0·00070	0·00494	0·0004
3	0·000150	0·00106	0·00742	0·0006
4	0·000200	0·00141	0·00989	0·0008
5	0·000250	0·00176	0·01237	0·0010
6	0·000300	0·00212	0·01484	0·0012
7	0·000350	0·00247	0·01732	0·0014
8	0·000400	0·00282	0·01979	0·0016
9	0·000450	0·00318	0·02227	0·0018
10	0·000500	0·003535	0·02474	0·0020
100	0·005060	0·03535	0·24747	0·0200
1000	0·050630	0·35353	2·47470	0·2000

In the oxygen column, 6 and 3 may be left out.

The first and under might be called the first quality of water; from 0·1 to 0·2, the second; 1 would be the tenth.

When it is considered better to acidify the water before adding the permanganate, this is done by adding 3 drops or water-grain measures of sulphuric acid to 1000 grains; some water will demand more; the object is to attain acidity equal to about 3 drops of sulphuric acid in 1000 grains of distilled water. I find Dr. Miller says 50 grains of diluted sulphuric acid (1 of acid to 3 of water) added to 8 ounces of water. Acid enables the oxygen to act on more matter, and more rapidly. Alkalies prevent the action, although they may prepare some of the matter to be more readily oxidised: when the colour has been difficult to see, the chameleon may have been used with alkali instead of acid, in which case a green colour is obtained, serving usefully as a corroboration.

As an illustration of the mode of examining water so as to obtain the first and the second conditions, if we may so call them, of organic matter, I will quote here a short paper, read to the Philosophical Society of Glasgow, on the water of the river Clyde. I think I there gave the proper use of the permanganate of pot-

ash.* There is a very sharp separation between those substances that decompose the permanganate at once and without acid and those which do so on the addition of acid, and after a short time. So decided is this, that I consider them as indicating two different conditions of organic matter.

"I thought it would be interesting to test the Clyde in this way, and for that purpose obtained specimens at various points from near Bothwell to the sea, afterwards continuing till the vessel came near Liverpool.

"The column to observe is number 1 of annexed table of either series. This gives the amount of oxygen consumed instantly, and corresponds, as I believe, to the amount of decomposed matter which has left in solution putrid gases, whatever these gases may be. We may suppose them to be sulphuretted hydrogen in minute quantities, or compounds of sulphur, or organic substances only, or all mixed. In the part of the Clyde near Glasgow, all these compounds will probably be found; as we go near the Firth, the sulphur will be fully oxidised, and the organic compounds only will be the active agents in taking up the oxygen, as they oxidise more slowly.

"The amount of oxygen is calculated from the amount of permanganate employed. The method is an extension of the original idea given out by the late Forchhammer many years ago; the amount of water used was 100 c.c., or 1544 grains. The permanganate required to give perfectly pure water perceptible colour was in every case subtracted from the number obtained.

"The examination of the Clyde is not perfect, but there is much to be seen that is interesting. Specimens ought to have been taken higher than any town on the river.

"The first was taken about 6½ miles above the quay at Glasgow. We there find the oxygen required for the water to be 0·000045 per cent by weight, or equal to 3·15 grains per 100 gallons. When we come to the Broomielaw, at Glasgow, we find the amount of oxygen demanded had risen to 0·000022 per cent by weight, or 15·40 grains per 100 gallons.

"We then see it steadily diminishing; and when we arrive at Port Glasgow, 20 miles down, it has become equal to that at 6½ miles above Glasgow. If we had taken the north side, below Dumbarton, instead of the south, on which the vessels sail, the difference would have been greater.

"Leaving Greenock, and turning the point, we have a rapid change; and when off the west of Gourock Bay, at the distance kept by the Liverpool vessels, the amount of oxygen demanded fell to 1·05. Off Wemyss Bay, the fall is remarkably low; but it is not always so, as it depends on tide and wind. The current seems to run down the centre, whilst the ocean water comes up the coast. The winds and floods may modify this.

"We have to observe a complete change about Gourock or the Cloch, if we keep to the south and east side; but, if we keep to the north, the greatest change is perceptible not far off Helensburgh.

"This wide space of water reduces the amount of oxygen required to 0·00001 per cent by weight, or 0·7 grain per 100 gallons.

"We are now led to ask if the purest state of the water is attained here. We may go further towards the open sea, and find that the amount required falls to 0·000005 per cent by weight, or 0·35 grain per 100 gallons. This is at Arran, where the sea is more extensive, and oxidation, even of the peaty matter from the hills, is nearly completed. We observe this to continue till the entrance of the North Atlantic is past; and, as we come south, to a narrower channel, the amount of oxidisable matter increases, and keeps up steadily till we arrive at Liverpool. No specimen was taken nearer than 17 miles from Liverpool. The point 0·00001 per cent oxygen by weight, or 0·7 grain per 100 gallons, is an important one to examine. We find that at Dunoon, Innellan, and Holy Loch, this amount may be called permanent. We may ask, Why does it not fall lower? and is it true that the sewage of Glasgow affects the Firth until we arrive at Lamlash, and obtain the number 0·000005 per cent oxygen by weight, or 0·35 grain per 100 gallons?

"We observe that the amount of purification is remarkably rapid whenever the Clyde widens, as at Greenock to Gourock; so that, even near Helensburgh, the number has fallen to 0·0000125 per cent oxygen by weight, or 0·875 grain per 100 gallons. This change, from 0·000045 or 3·15 grains per gallon has been effected in the space of about 2 or 3 miles. Is it possible, then, that the slight further change required demands all the wide distance between Gourock and Arran? I think not. The reason we do not find the number for oxygen falling below 0·00001 per cent by weight, or 0·7 grain per 100 gallons, at Holy Loch, Strone, Dunoon, and Cove, may be seen by examining the Lochs. We there find that they themselves send in water with the oxygen number 0·00001 per cent by weight, or 0·7 grain per 100 gallons.

"At this point we must remember that the oxygen may not all be required for putrid matter, and that the streams contain some peaty matter which may also instantly require oxygen. At any rate, we know this, that, for whatever they do require it, it can be for the destruction of no very unwholesome matter in the water, as the highland streams must be considered free from such taints. There is a little of the soil of cattle, when the weather is wet, but perhaps none when the weather is so dry that the water must pass through the earth before reaching the bed of the stream.

"We cannot, then, expect the sea-water to demand less oxygen than the streams and lochs that affect it here. In other words, we discover the influence of the land on the drainage from the hills, even when all trace of the influence of Glasgow has gone. This is, I believe, the reason that, according to circumstances, such as currents and weather, we observe the water of the Firth sometimes as pure as the deep sea, and at other times less so. At Wemyss Bay, for example, the table does not show this very well. This will happen at other parts of the coast when the streams enter purer than the usual sea-water there, as, for example, at Dunoon and Innellan, where the water flows from streams equal, when not in flood, to the deep Firth water. We see the influence of the coast, also, as we go on towards Liverpool, and between the Isle of Man and Lancashire.

"I considered that 0·00001 per cent oxygen by weight, or 0·7 grain per 100 gallons, marked the limits of the Glasgow sewage. If the sewage were not all ex-

* We never understood the author of this paper to claim having first used permanganate of potash for water. He readily acknowledges being later than Dr. Miller and Dr. Woods, and still later than Mr. Condy, who seems first to have carried out Forchhammer's idea. He simply wishes to show his mode of analysis and the results, leaving the question of merit entirely aside.—*Ed. C. N.*

pended, the amount would be greater, because the lochs and their streams do not show a higher number. Whenever the water of the Firth falls down to that of the streams, we are, as I suppose, receiving the air at least as pure as the air above the streams on the hills, and may be contented.

"Some people will perhaps demand more than this number. I have not made examinations far enough towards the ocean to enable me to speak of it; but it seems to me that the numbers 0·00001 per cent by weight, or 0·7 grain per 100 gallons, of the streams, and 0·00005 or 0·35 grain per 100 gallons, mark two very important points. The first characterises air which is certainly most wholesome and agreeable; the second is that ocean air which some persons require, but which to others is said to be too strong. On the meaning of this expression "too strong," I will not attempt to speak; but it is very much used by a great public, and it must have a wide foundation. It is apparently certain that to some it is important not to have the extremely strong or perhaps purest air.

"These observations seem most curiously to coincide with general observation. The current of the Clyde keeps to the south; and we see that the water changes less rapidly there. At the north the direct current is not much observed, and the influence of the lochs or fiords is seen. The water from them presses against the Clyde current, and aids in keeping it to the south-east. This has influenced the building of the numerous residences on the Argyle side, lining all the coast. The population has not found it needful to make a chemical analysis, but has seen where the purest water was with the unaided eye. A mode of observation, apparently quite as good as chemical analysis, is the examination of the rocks on the coast, the dark and dirty aspects of those in impure water being very striking.

"I am not, however, inclined to look on my work here as useless, although common observation has done its part so well. I believe it to be of great importance to us to be able to apply tests so as to prove the truth of popular belief, which is formed by long and tedious processes. With these little chemical experiments we may do the work in an hour, which the instincts and expensive experience of whole generations were required to perform.

"I believe that in these results we have a method of examining the coasts which will be valuable to us as a sanitary police. It can be applied wherever there are sheets of water.

"I will not say that these numbers represent the relative wholesomeness of places on the land and on the sea; but I think it probable that they may fairly be used as comparisons of places on the sea only. When the land is in question, there are many sources of emanations to be considered.

"To be complete, the examination ought to be continued for several years. Last year was not an average one; there was much rain. (This regarding the Clyde and the sea was read in Dec. 1866.)

"There are floods in the Clyde which bear down so much water that the brown peaty matter is readily seen below Dunoon; but on these occasions there is no fear of putrid matter, as the water carried down is so abundant. At the same time there will be a certain degree of purity less at the sea-entrance, corresponding to the greater degree of purity caused by the flood at Glasgow. By this it is not meant that the water as low as Cloch or Dunoon is affected by more than an infinitesimally small amount of the sewage matter which is washed past Glasgow in floods, whilst at other times the effect has ceased, as before said, at least on the north, below Helensburgh. There is, however, a little muddiness observable for many miles, and this will be found even in places where the oxidation of all the readily transported matter has taken place.

"Even where total oxidation has occurred, a little muddy matter remains. It consists chiefly of earthy bodies, which may float until they obtain a suitable place for deposit.

"It would be interesting to find the time needful to perform this change on the organic matter of Glasgow. We see that the great bulk of the purification is performed in the fresh water. At Dumbarton it must be rare indeed that anything can be known to exist in the water from its smell. When the Clyde passes into the estuary, which may be said to begin at the Rock of Dumbarton, the change is effected by spreading the water over many square miles, and preparing it effectually for those who enter the sea- and loch-regions below Helensburgh. Below this point it is not a river on which we are, but an arm of the sea, protected on all sides from oceanic waves.

"The water bears the qualities of coast-water in proportion to its excessive length of coast. This quality must exist more or less on all coasts which have fresh springs running into them. In cases where the rivers are large or numerous, the evil of the meeting of fresh and salt water is well known. On the Firth of Clyde no large bodies of fresh water are found after we leave the mouth of the river portion of the Clyde; and, as observed, these streams are remarkably pure, or, if coloured, it is only by peat-water. The absence of great rivers is therefore an advantage of an important kind to this coast.

"I was extremely glad to be able to speak thus favourably of the districts which are so agreeable to me; but I am certainly desirous of speaking still more favourably of some which are too much affected by Glasgow. They may be constantly deteriorating. This is a very serious matter, not merely for owners of property on the Firth, but for all the inhabitants of Glasgow, who are favoured more than those of any other large city in the kingdom by a ready access to this wonderful sanitorium.

"In making these remarks, I take it for granted that the air above the water will be pure in inverse proportion to the amount of volatile oxidisable matter.

"We must not, however, forget that, if the river is rendered impure, the town is proportionately purified. And we must also remember that the work done in the water is enormous. If the refuse matter were allowed to evaporate into the air, and so collect its oxygen, the act of purification would go on in the air we breathe; but now the water draws in oxygen, and, as soon as it is consumed, it draws in more. Even the air over the river is, at a distance of a few miles down, purer than the air of many towns; and when the spaces widen, the case is stronger still.

"I have sometimes inquired if we obtained in fish an equivalent of the manure sent out, and if it is not easier to gather the crop in boats than to put the manure laboriously on land. I find, however, that the loss by putrefaction, oxidation, and evaporation is so rapid that there was no hope of it being used profitably. In one current examined, a very deep one, and much stronger in sewer matter than the Clyde

ever is, the whole nitrogen had disappeared in three days, the greater part in much less.

"Whilst the chief object of my paper is to show a new mode of examining climate as well as streams, I am glad to be able to say that Glasgow has failed to destroy the purity of the Firth beyond the points indicated, and that we may still rejoice in our summer dwellings. It is, however, not to be forgotten that the effects are found too far away, and that twenty-two miles of mischief is more than abundance. It is to be hoped that the cautious policy of the City in waiting for the best method to be adopted for using its refuse will enable it to carry out that future work, whatever it may be, with the greatest success.

"I have referred only to the 1st column: it indicates the amount of permanganate decomposed instantly; this represents the gases of decomposition, such as most readily pass into the atmosphere.

"It will not be supposed that this is the only offensive matter.

"The 2nd column represents the amount when acid is used to assist the oxidation. I suppose this to represent the amount easily decomposed.

"The 3rd column of the original paper, left out here, represents the amount of oxygen used by the organic matter in twenty-four hours. I do not at present see its use. I do not think this at all a fair mode of representing the impurity of water, unless we are sure that the quality does not change. We see this by the numbers above, and at Glasgow Bridge. The purer water has, by this mode of representing it, the appearance of being equal to the worst. The only column that gives the continuous increase and decrease exactly as the senses find the case to be, is the column No. 1.

Time.	Oxygen per 100 gallons required to oxidise		Oxygen by weight required to oxidise 1,000,000	
	I. The decomposed organic matter.	II. The easily decomposable organic matter.	I. The decomposed organic matter.	II. The easily decomposable organic matter.
Aug. 15, '66.				
6¼ miles above Glasgow 3.30 p.m.	3·15	11·55	45·0	165·0
5½ miles above Glasgow 3.15 "	4·55	9·45	65·0	135·0
5 miles above Glasgow, Cambuslang..... 3 "	5·95	11·20	85·0	160·0
Broomielaw ..... 1.30 "	15·40	22·05	220·0	315·0
Mouth of Kelvin..... 1.20 "	11·55	18·20	165·0	260·0
100 yds. below Renfrew 1 "	10·85	25·55	155·0	365·0
100 yds. above Bowling 12.45 "	4·55	8·05	65·0	115·0
At Dumbarton.. ..... 12.30 "	4·55	6·65	65·0	95·0
Between Greenock and Port Glasgow..... 12.10 a.m.	3·15	4·20	45·0	60·0
July 25, '66.				
Gourock ..... 12.55 p.m.	1·05	1·75	15·0	25·0
Cloch..... 12.45 "	1·05	1·57	15·0	22·5
Inverkip ..... 12.30 "	0·70	1·40	10·0	20·0
Wemyss Bay..... 12.15 "	0·35	0·87	5·0	12·5
Opp. Toward..... 12 noon.	0·70	1·05	10·0	15·0
Between Toward and Cumbrae..... 11.30 a.m.	0·70	1·05	10·0	15·0
Opp. Cumbrae Lighth. 11 "	0·70	0·87	10·0	12·5
Opp. Lamlash ..... 10.15 "	0·35	0·70	5·0	10·0
July 25, '66.				
188 ..... 10 a.m.	0·35	0·87	5·0	12·5
176. Ailsa Craig..... 9 "	0·35	0·73	5·0	10·0
160. From Liverpool.. 8 "	0·35	0·87	7·5	12·5
131. From Liverpool.. 6 a.m.	0·52	0·87	7·5	12·5
103. " " 4 "	0·52	0·87	10·0	12·5
74. N. of Isle of Man 2 "	0·70	1·05	12·5	15·0
July 24, '66.				
46. From Liverpool.. 12 night.	0·87	1·22	12·5	17·5
32. " " 11 p.m.	0·87	1·40	12·5	20·0
17. " " 10 "	1·05	1·75	15·0	25·0
Aug. 13, '66.				
Off Greenock..... 5·10 p.m.	1·40	1·57	20·0	22·5
Aug. 15, '66.				
Off Helensburgh .... 6·35 p.m.	0·875	1·22	12·5	17·5
Aug. 13, '66.				
Off Gourock..... 5 p.m.	1·22	1·57	17·5	22·5
Aug. 13, '66.				
Between Kirn and Gourock..... 6 p.m.	1·22	1·40	17·5	20·0
July 30, '66.				
Arrowchar (Loch Long) 1·30 p.m.	0·70	1·05	10·0	15·0
Aug. 15, '66.				
Off Mouth of Loch Long 6·55 p.m.	0·875	1·40	12·5	20·0
Aug. 17, '66.				
Head of Loch Goil.... 1.5 p.m.	0·875	1·05	12·5	15·0
Entrance of Loch Goil 4.30 "	1·05	1·22	15·0	17·5
Aug. 1, '66.				
Head of Holy Loch... 2·45 p.m.	0·70	1·57	10·0	22·5
Middle of Holy Loch.. 2·30 "	0·52	1·05	7·5	15·0
July 31, '66.				
Dunoon (several 100 yds. from shore).... 1 p.m.	0·70	1·22	10·0	17·5
Dunoon (about 800 yds. from shore)..... 1.15 "	0·70	1·22	10·0	17·5
Aug. 16, '66.				
Off Dunoon ..... 1 p.m.	0·70	0·875	10·0	12·5
Aug. 20, '66.				
Stream at West Bay, Dunoon ..... 1 p.m.	0·52	0·70	7·5	10·0
Stream between Innellan and Dunoon.... 12 noon.	0·35	0·52	5·0	7·5
Aug. 16, '66.				
Between Innellan and Dunoon ..... 1·8 p.m.	0·875	1·05	12·5	15·0
Off Innellan ..... 1·15 "	0·70	0·875	10·0	12·5
Aug. 9, '66.				
Off Wemyss Bay (high tide)..... 12 noon.	1·05	1·22	15·0	17·5
Off Wemyss Bay (low tide)..... 4.30 p.m.	0·875	1·22	12·5	17·5

"It is not, however, meant that the gases of decomposition are the only evils to be apprehended from impure water; but, so far as I know, they are those that affect the air principally (from this source). The most dangerous bodies are probably in the water itself and it is possible that they may not be affected by the process of column 1.

"I am not inclined to draw any important conclusion from the total organic matter without inquiring into its character. At present, I believe, we are quite safe in attending to the conclusions here given in column 1, with such precautions as I have elsewhere indicated —when, for example, nitrites, sulphites, &c., are present. By and by we shall learn the true mode of dealing with the other columns."

(To be continued.)

RESEARCHES ON VANADIUM.*

BY HENRY E. ROSCOE, B.A., PH.D., F.R.S.

Part II.

On the Chlorides of Vanadium and Metallic Vanadium.

In the first part of these researches ("Bakerian Lecture," *Phil. Trans.*, 1868, pt. i.) the author stated that the chlorides of vanadium, and probably also the metal itself, could be prepared from the mononitride, the only compound of vanadium not containing oxygen then known. The process for obtaining the mononitride described in the last communication was that adopted by Berzelius for preparing the substance which he conceived to be metal, but which, in reality, is mononitride. This method consists in the action of ammonia on the oxitic chloride; but it cannot be employed for the preparation of large quantities of nitride, owing to the violence of the action and consequent loss of material. The author, seeking for a more economical method, found that if the ammonium metavanadate (NH_4VO_3) be heated for a sufficiently long time at a white heat in a current of dry ammonia, pure vanadium mononitride remains behind. Analysis of a sample thus prepared gave 79·6 per cent of vanadium and 20·2 per cent of nitrogen, theory requiring 78·6 and 21·4 per cent respectively. The mononitride may likewise be directly prepared by igniting vanadium trioxide (V_2O_3) in a current of ammonia at a white heat in a platinum tube, and also by subjecting the dichloride to the same treatment.

The Chlorides of Vanadium.—Three chlorides of vanadium have been prepared, viz.:—

Vanadium tetrachloride	VCl_4
Vanadium trichloride	VCl_3
Vanadium dichloride	VCl_2

1. *Vanadium Tetrachloride*, VCl_4, molec. wt.=193·3, V.D =96·9 (H=1).—This chloride is formed as a dark reddish brown volatile liquid, when metallic vanadium or the mononitride is burnt in excess of chlorine. The first method adopted for the preparation of this chloride was to pass dry chlorine over the mononitride heated to redness; the whole of the nitride volatilises and a reddish brown liquid comes over. In one operation 44 grains of the crude tetrachloride was thus prepared; the liquid is purified by distillation, first in a current of chlorine and then in a stream of carbonic acid gas. On fractionating, the liquid was found to boil at 154°C. (corrected) under 760 m.m. of mercury. The second method depends upon a fact already noticed in the preceding communication, that the oxytrichloride ($VOCl_3$), prepared, according to the directions of Berzelius, by passing dry chlorine over a mixture of the trioxide and charcoal, possesses a port-wine colour instead of the canary-yellow tint of the pure substance. This dark colour is due to the formation of the tetrachloride of vanadium, and if the vapours of the oxytrichloride, together with excess of dry chlorine, be passed several times over a column of red-hot charcoal the whole of the oxygen of the oxychloride can be removed, and at last perfectly pure tetrachloride, boiling constantly at 154°, is obtained. This reaction, it will be remembered, served first to demonstrate the existence of oxygen in the oxytrichloride. In each distillation of the tetrachloride a peach-blossom coloured solid residue remained in the bulbs; this substance is vanadium trichloride, and it slowly burns away in excess of chlorine when heated, forming tetrachloride.

The composition of the tetrachloride was established by six well-agreeing analyses, made from several different preparations. The mean result is:—

	Calculated.	Found.
V = 51·3	26·54	26·87
Cl_4=142·0	73·46	73·02
	193·3	100·00	99·89

Owing to the facility with which the tetrachloride splits up into trichloride and chlorine, a solid residue was left in the vapor-density bulb, and the density of the vapour (at 219°) was found by Dumas's method to be 99·06 (or 6·86) instead of 96·6 (or 6·69). By volatilising the liquid in a small bulb, and allowing the vapours to pass into a large bulb already heated above the boiling-point of the liquid, this deposition of trichloride was avoided, and the density was found to be 96·6 or 6·69 at 205°, and 93·3 or 6·48 at 215°, the last determination indicating that a partial decomposition into VCl_3 and Cl had occurred. The specific gravity of the liquid tetrachloride at 0° is 1·8584; it does not solidify at −18°, nor does it at this or any higher temperature undergo change of properties on treatment with chloride. It not only undergoes decomposition on boiling, but at the ordinary atmospheric temperatures it splits up into VCl_3 and Cl. Tubes in which the liquid chloride had been sealed up have burst by the pressure of the evolved chlorine. Thrown into water, the tetrachloride is at once decomposed, yielding a blue solution identical in colour with the liquid obtained by the action of sulphurous or sulphydric acids on vanadic acid in solution, and containing a vanadous salt, derived from the tetroxide V_2O_4. In order to prove that a vanadous salt is formed when the tetrachloride is thrown into water, the solution thus obtained was oxidised to vanadic acid by a standard permanganate solution. The calculated percentage of oxygen thus needed, according to the formula

$$2VCl_4 + O + 4H_2O = V_2O_5 + 8HCl$$

is 4·14; the percentage of oxygen found by experiment was 4·11.

The solution of the tetrachloride in water does not bleach; but if the vapour be led into water a liquid is obtained which bleaches litmus. Vanadium tetrachloride acts violently on dry alcohol and ether, forming deep-coloured liquids. The author is engaged upon the examination of this reaction.

Bromine and vanadium tetrachloride, sealed up and heated together, do not combine; on the contrary, trichloride is deposited. Hence it is clear that vanadium does not readily form a pentad compound with the chlorous elements.

2. *Vanadium Trichloride*, VCl_3=157·8.—The trichloride is a solid body, crystallising in splendid peach-blossom coloured shining tables, closely resembling in appearance the crystals of chromium sesquichloride. It is non-volatile in hydrogen, and, when heated in the air, it decomposes, glowing with absorption of oxygen, and forming the pentoxide. Heated in hydrogen, the trichloride first loses one atom of chlorine, forming the dichloride (VCl_2), and afterwards, on exposure to a higher temperature, loses all its chlorine, leaving metallic vanadium as a grey lustrous powder. The trichloride is extremely hygroscopic, deliquescing on exposure to air to a brown liquid. The trichloride is best prepared by the quick decomposition of the tetrachloride

* Abstract of a paper read before the Royal Society, June 17, 1869.

at its boiling point, or by its slow decomposition at the ordinary temperature of the air. The crystalline powder obtained by either of these methods only requires freeing from adhering tetrachloride, by drying in carbon dioxide at 160°, in order to yield good analytical results.

	Calculated.	Mean of 4 analyses.
$V = 51{\cdot}3$	32·5	32·57
$Cl_3 = 106{\cdot}5$	67·5	67·42
157·8	100·0	99·99

The trichloride thrown into water does not at once dissolve; but, as soon as the crystals get moistened, a brown solution is formed, which becomes green on addition of a drop of hydrochloric acid, and contains a hypovanadic salt in solution. This green tint is identical with that got by reducing a solution of vanadic acid in presence of magnesium. According to the equation—

$$2VCl_3 + O_3 + 3H_2O = V_2O_5 + 6HCl$$

the solution of the trichloride requires 10·14 per cent of oxygen to bring it up to vanadic acid, whilst analysis showed that 10·1 per cent was necessary. The specific gravity of the trichloride at 18° is 3·00.

3. *Vanadium Dichloride*, $VCl_2 = 122{\cdot}3$.—The dichloride is a solid, crystallising in fine bright apple-green micacious plates. It is prepared by passing the vapour of vanadium tetrachloride mixed with hydrogen through a glass tube heated to dull redness. If the heat be pushed further, a blackish crystalline powder, consisting of a mixture of lower chloride and metal, is obtained. The dichloride, when strongly heated in hydrogen, loses all its chlorine, leaving vanadium in the metallic state in grey crystalline grains. Analysis gave:—

	Calculated.	Mean of 2 analyses.
$VCl = 51{\cdot}3$	41·95	42·16
$Cl_2 = 71{\cdot}0$	58·05	57·88
122·3	100·00	100·00

Vanadium dichloride is extremely hygroscopic; when thrown into water, a violet-coloured solution is formed, identical in tint with the liquid containing a hypovanadous salt obtained by reducing vanadic acid in solution in presence of zinc or sodium-amalgam; and like this latter liquid, the solution of dichloride in water bleaches strongly by reduction.

Oxidised by permanganate, this liquid required 18.78 per cent oxygen (on the dichloride taken) to bring it up to vanadic acid, whereas the equation—

$$3VCl_2 + O_3 + 2H_2O = V_2O_5 + 4HCl$$

requires 19·6 per cent. The specific gravity of vanadium dichloride at 18° is 3·23.

Metallic Vanadium, $V = 51{\cdot}3$.—Although from what we know of the characters of vanadium, it appeared unlikely that any compound containing oxygen would yield the metal by direct reduction, the author has repeated the experiments of other chemists on this subject, but without success. There is no doubt that the metal cannot be obtained by any of the processes described in the books. The only methods which promised possible results were:—

1. The reduction of a vanadium chloride (free from oxygen) in hydrogen gas, either with or without sodium.
2. The reduction of the mononitride at a white heat in hydrogen.

The first of these methods has proved to be successful, whilst the second does not appear to yield metal, inasmuch as the nitride exposed for 3½ hours in a platinum tube to the action of hydrogen at a white heat, lost only 8 per cent, whereas it must lose 21·4 per cent on conversion into metal.

Notwithstanding the apparent simplicity of the method, the author has found it exceedingly difficult to obtain the metal perfectly free from oxygen. This arises from the fact that, whilst vanadium is quite stable at the ordinary temperature, it absorbs oxygen with the greatest avidity at a red heat, and that, therefore, every trace of air and moisture must be excluded during the reduction. Another difficulty consists in the preparation of the solid chlorides in large quantity and free from oxygen or moisture, as also in the length of time needed to reduce these chlorides in hydrogen, during which time unavoidable diffusion occurs, and traces of oxygen enter the tube. Again, the reduction can only be effected in platinum boats placed in a porcelain tube, as the metal acts violently on glass and porcelain, and tubes of platinum are porous at a red heat.

A description of the apparatus employed is then given, the main points being to guard against diffusion, and to introduce the powdered dichloride into the platinum boat in such a way that it shall not for an instant be exposed to moist air. After all precautions are taken, the tube is heated to redness, torrents of hydrochloric acid come off, and the evolution of this gas continues for from 40 to 80 hours, according to the quantity of dichloride taken. After every trace of hydrochloric acid has ceased to be perceptible, the tube is allowed to cool, and the boat is found to contain a light whitish grey-colored powder, perfectly free from chlorine.

Metallic vanadium thus prepared, examined under the microscope, reflects light powerfully, and is seen to consist of brilliant shining crystalline metallic mass, possessing a bright silver-white lustre. Vanadium does not oxidise or even tarnish in the air at the ordinary temperature; nor does it absorb oxygen when heated in the air to 100°. It does not decompose water even at 100°, and may be moistened with water, and dried *in vacuo*, or at 100°, without gaining weight. The metal is not fusible or volatile at a bright-red heat in hydrogen; the powdered metal thrown into a flame, burns with the most brilliant scintillations. Heated quickly in oxygen, it burns vividly, forming the pentoxide; but slowly ignited in air, it first glows to form a brown oxide (possibly V_2O), and then again absorbs oxygen, and glows with formation of the black trioxide and blue tetroxide, till it at last attains its maximum degree of oxidation. The specific gravity of metallic vanadium at 15° is 5·5. It is not soluble in either hot or cold hydrochloric acid; strong sulphuric acid dissolves it on heating, giving a yellow solution; hydrofluoric acid dissolves it slowly with evolution of hydrogen; nitric acid of all strengths act violently on the metal, evolving red nitrous fumes, and yielding a blue solution: fused with sodium hydroxide, the metal dissolves with evolution of hydrogen, a vanadate being formed.

One sample yielded on oxidation a percentage increase of 77·94, whereas that calculated from metal to pentoxide is 77·98. Another preparation gave a percentage increase of 70·8, showing the presence of a small quantity of oxide. On treatment in a current of chlorine, metallic vanadium burns and forms the reddish-black tetrachloride; heated in a current of pure nitrogen, the mononitride is formed.

The properties of the compounds of vanadium with silicon and platinum are then described in the memoir.

[English Edition, Vol. XX., No. 504, pages 37, 38.]

ON

COLOPHONINE AND COLOPHONIC HYDRATE,

NEW SUBSTANCES PROCURED FROM THE PRODUCTS OF THE DESTRUCTIVE DISTILLATION OF RESIN.*

BY CHARLES R. C. TICHBORNE, M.R.I.A., F.C.S., ETC.

When we submit to distillation (either with or without water) the natural exudations of the different pines, the first result is the extraction of volatile hydrocarbons, or oils of turpentine. These oils were, until very lately, considered as identical, but recent investigations have proved that there is a considerable disparity in the products from different species of the pines. If, after the extraction of the volatile oils, the distillation is pushed further, we get a second series of volatile compounds, which, however, differ materially from the first, inasmuch as they are decomposition products, resulting from the splitting up of the colophony, or resinous part, into more simple molecules of different isomeric modifications.

All the resin oils obtained by myself gave the result I am now about to detail. I, however, believe that the discrepancies exhibited by the turpentines are perpetuated through the products obtainable upon the destructive distillation of the resins proper to such turpentines.

My attention was first directed to the substance which I have named colophine from an observation made preparatory to investigating the volatile oils procured on submitting resin to destructive distillation.

I took commercial resin, and, after drying for some time at a slightly elevated temperature, distilled it in an iron retort. I got, by this means, a thick distillate, which contained a considerable quantity of undecomposed resin. Gaseous products escaped which are said to contain ethylene, tetrylene, and marsh gas. The liquid products amounted to about 74 per cent of the resin employed, and a small coke was left in the retort. This thick oil, on rectification, gave about 5 to 6 per cent of a light yellow but mobile fluid, which is known under the names of "resin spirit," "vive essence," "Harzessenz." †

This lighter portion, or "resin spirit," is supposed to consist mainly of the hydrocarbons homologous of the series $C_n H_{2n-4}$ and $C_n H_{2n-6}$, and an oxygenated oil, which has been named colophonone.‡ It is these light oils that yield colophonic hydrate. They act energetically upon the fluid alloy of potassium and sodium, even when free from the last-named substance; therefore it is probable that colophonone, or other oxygenated oils, form a large ingredient.

It is given as a specific characteristic of colophonone, that, if it is treated with sulphuric or hydrochloric acid, a green oil separates on the addition of water. This is, however, only partially true; for I found that the "resin spirit"§ procured in the above experiment, or old resin spirit that had been washed, only gave this reaction in a slight degree.

It was, therefore, evident that the colour-phenomenon was due to the presence of some other substance soluble in water, and not to a specific property of the colophonone. On treating old resin spirit with distilled water two or three times, and on evaporating these washings at a low temperature, a brown crystalline mass was procured, which gave the colour-reactions, hitherto attributed to the oil itself, in a most vivid manner. It therefore becomes evident that the whole subject of colophonone requires revision. It was probable that the substance analysed under that name was a mixture.

I subsequently obtained specimens of the new substance in which individual crystals had attained some considerable magnitude.

Some of them were 3 centimetres long, and over 2 grammes in weight. They were of an amber colour, from impurities, and were obtained by submitting a large volume (10 litres) of the spirit, in an imperfectly-closed vessel, to twelve months' slow evaporation and oxidation. I have procured as much as 281 grammes of the crude crystals from 4·5 litres of resin spirit by washing.

The following are the characteristics of this compound, which, when purified, is a truly beautiful substance:—

Colophonic hydrate is white, perfectly odourless, and has a sweetish taste; it is very soluble in water, alcohol, ether, chloroform, and tetrachloride of carbon; not quite so soluble in cold benzole and resin spirit, but slightly soluble in cold bisulphide of carbon.

Colophonic hydrate crystallises readily from water or alcohol, in beautiful acicular prisms, which sometimes attain some magnitude. Heated, it melts and sublimes, with a partial loss of the elements of water. The crystals which first sublime lose water, but nearly resemble those obtained from a solution, both as regards their appearance and composition. Those which afterwards rise (or if the first are re-sublimed) lose more water, and form hexagonal plates, or fern-like fronds, of great beauty. It was found impossible to accurately measure the large crystals already mentioned, the twelve months' immersion having rounded and worn the faces, from the rise and fall of temperature in the medium in which they are formed. They seem to belong to the dimetric system, and are the result of the combination of the two prisms of that system.

The hydrated crystals, when placed over sulphuric acid, or *in vacuo*, gradually lose water, and effloresce; but, as the substance is itself volatile, the loss could not be measured under such circumstances. When placed under a bell-glass over sulphuric acid, the surface of the acid becomes covered with a green film, produced, as will be afterwards explained, by the mutual action of the water, sulphuric acid, and colophonic hydrate. Some difficulty was experienced in procuring the anhydrous compound. From the above results, it was supposed that, on submitting the hydrate to sublimation, the water of hydration would be dissociated. Such, however, was not the case, and a combustion of the sublimed crystals pointed to no formula. The sublimate was, in fact, a mixture of the anhydrous and hydrated compounds.

The first of these substances I obtained in the following manner:—I gently fused, in a test-tube, for some time the crystals obtained from an aqueous solution, occasionally drying out the moisture which condensed at the top of [illegible]per. The sublimed cryst[illegible]nd mixed with the [illegible] as long as

* Communicated by the author. Read before the Royal Irish Academy.

† Mr. J. Turner, a large distiller of resins, has kindly sent me the following notes regarding the statistics of the production of these oils on a manufacturing scale:—

	Percentage.
"Resin spirit" (boiling at 135° C.)	5·3
Heavy oils	64·6
Pitch	14·4
Gaseous products and H_2O	15·7

‡ Schiel.

§ I shall use the term "resin spirit" throughout this paper, to designate the light oils got on rectifying resin oils.

line mass for analysis. It seemed to have suffered no decomposition, exclusive of dehydration, and formed a friable and nearly perfectly white substance.

On making a combustion of the above, 0·218 gramme gave 0·505 gramme CO_2, and 0·218 gramme H_2O.

In a second experiment, 0·307 gramme of the fused mass gave 0·7076 gramme of CO_2, and 0·324 gramme of H_2O.

These experiments point to the empirical formula $C_{10}H_{22}O_2$.

	I.	II.	Theory.	
Carbon	63·16	62·86	63·15	120
Hydrogen	11·10	11·72	11·58	22
Oxygen			25·27	48
			100·00	190

The crystals obtained from an aqueous solution gave, when burnt, the following results:—0·265 gramme of crystals produced 0·557 gramme of CO_2, and 0·270 gramme of H_2O.

		Theory.	
Carbon	57·35	57·70	120
Hydrogen	11·32	11·53	24
Oxygen		30·77	64
		100·00	208

Colophonic hydrate $C_{10}H_{22}O_2 : H_2O$.
Colophonine $C_{10}H_{22}O_2$.

Colophonine is, therefore, isomeric with terpine hydrate, or is, more properly, a homologue of terpine. It is another instalment towards filling up an interesting series. This compound is probably derived from terebene.

Hydrocarbides.	Products formed therefrom by the occult molecule H^2O ("Turpentine Camphors.")	Hydrates.
$C_{10}H_{16}$, $C_{10}H_{16}$. ("Diterebene.")	$C_{10}H_{16}.C_{10}H_{16}$; H^2O.* ("Terpinole.")	
$C_{10}H_{16}$ (α) (Turpentine, or "terebenthene.")	$C_{10}H_{16}$; H_2O ("Liq. Turpentine Camphor.")	$C_{10}H_{16}$: H_2O: H_2O. Hypothetical hydrate, supposed transition products
	$C_{10}H_{16}$; $2H_2O$. ("Terpine.")	$C_{10}H_{16}$; $2H_2O$: H_2O (Terpine hydrate.)
$C_{10}H_{16}$. (β) ("Terebene.")	$C_{10}H_{16}$; $3H_2O$. (Colophonine.)	$C_{10}H_{16}$; $3H_2O$: H_2O. (Colophonic hydrate.)

In the above table I have endeavoured to convey, by the punctuation, the accretion of the series, and the different degrees of molecular integration.

It will be observed that each hydrate would be isomeric with the next higher homologue in the camphor series. The hydrates to the first two in the series are wanting, but it is probable that they exist, as the compound called liquid turpentine camphor is, in the presence of water, converted into terpine, the isomer of its hydrate. If we do not suppose that the hydrate is first formed, we could hardly account for the formation of terpine.

Colophonic hydrate was violently acted on by bromine, accompanied by a copious separation of carbon and hydrobromic acid. In water, the action was more manageable, and the ultimate product was a brominated oil, which, after washing, first with a diluted solution of carbonate of sodium and then with water, was dried over sulphuric acid. 0·471 gramme of this oil, after being decomposed in a sealed tube with pure soda, was treated with an excess of nitric acid and nitrate of silver. It gave 0·766 gramme of bromide of silver, agreeing very nearly with the formula of a tetrabrominated compound.

Professor Jellett, who kindly examined this substance for me as regards its optical properties, finds that it is perfectly inert when in solution, and possesses neither right nor left-handed rotation.*

As previously stated, the light oils from resin when treated with sulphuric acid, and then with water, produce a green substance. This colouration is, however, due to the presence of colophonic hydrate. On treating that compound with acids, a series of striking phenomena is exhibited, conjugated acids being formed, which exhibit a fine display of colours. The generality of these are green. Sulphuric, phosphoric (monobasic and tribasic), arsenious, citric, and tartaric acids give these reactions.

On treating the crystals with an excess of the acid, and then adding spirit, the colour is developed. It is necessary to use heat in most cases. The sulphuric acid reaction is capable of rendering evident a milligramme of the new substance, if properly applied. It is not necessary to use heat in this case. Under certain circumstances, hydrochloric acid is capable of producing this green reaction; but when colophonic hydrate is treated with an excess of strong hydrochloric acid, after the expiration of half an hour, a brilliant rose colour is developed on pouring it into alcohol. If the experiment is pushed further, different shades of violets are produced, until the ultimate result of the maceration is a magnificent indigo blue.

Terpine hydrates do not give any of these reactions. The coloured solutions give absorption spectra, represented by the accompanying diagram. The longitudinal lines *A*, *a*, *B*, *C*, &c., represent the position of the solar lines. The thickness of the dark bands represents intensity of absorption, in a similar manner to Bunsen's graphic method used for metal spectra. Fig. 1 is the spectrum seen on viewing an alcoholic solution of the sulphuric compound. Dr. Reynolds, to whom I showed this spectrum, noticed that, when the acid is first mixed, the spectrum shows an absorption between the lines *D* and *E*, *β*, Fig. 1; this, however, after a little time, begins to fade from its more refrangible end, the centre of the spectrum gradually clearing, until the band is lost, and the spectrum, Fig. 2, obtained, the band *a*, *a'*, being intensified. Hydrochloric acid spectra behave in a somewhat similar manner, the ultimate result, either from age or boiling, being a spectrum similar to Fig. 3, the bands *a*, *a'*, slowly fading. These results would lead to the inference that the normal colour is purple, which is afterwards converted into the green compound.

As regards the origin of colophonic hydrate, it is probably formed under similar circumstances to the terpine camphors, *i.e.*, by oxidation, or the assimilation of the elements of water. I have failed, however, in forming this substance artifically by oxidising the resin spirit with nitric acid.†

* Formed by the action of dibromhydrate of citrene on acetate of silver—

$$2(C_{10}H_{18}Br_2) + 4(C_2H^3AgO_2) - 4(AgBr) - 2(C_2H_4O^2) - \left.\begin{matrix}C_2H_2O\\C_2H_2O\end{matrix}\right\}O = C_{20}H_{34}O.$$

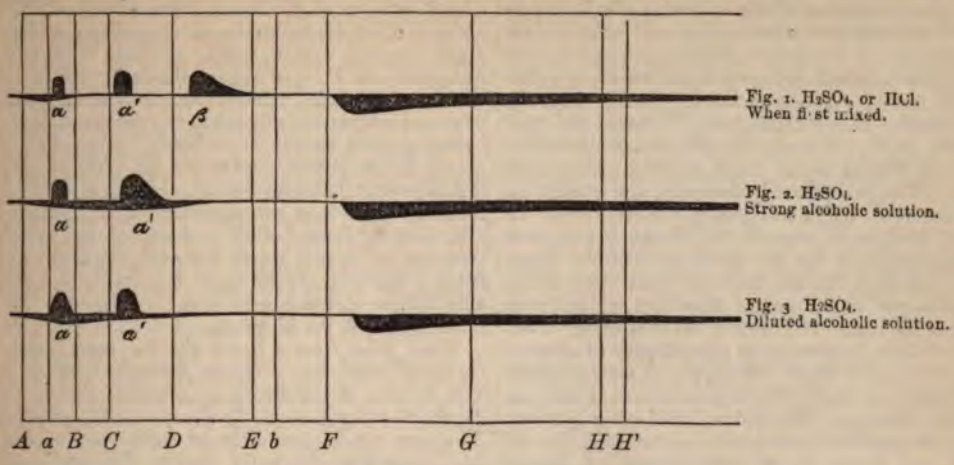
(Terpinole.)

Vide "Naquet's Principles," p. 396.

* It does not differ in this respect from its congeners the terpine hydrates, and similar products, in which, although the hydrocarbide preserves its integrity, its gyratory power is suspended.

† Mr. Turner forwarded me from England a bottle containing resin spirit, in which he had observed crystals. They proved, on examination, to be colophonic hydrate. The bottle originally contained about 8 ounces, but, from evaporation, only ½ an ounce remained; it consisted of about 25 per cent of colophonic hydrate. It had been exposed to sunlight for about eight years—light, however, is not essential to the formation of this compound.

It is not present in newly-prepared resin spirit, as I have already explained; and, as my supply of colophonic hydrate was expended, my researches upon this substance were, I am sorry to say, brought to a close. It is, however, my intention to renew them at a future period.



CONTRIBUTIONS TO OUR KNOWLEDGE OF

NATURAL WATERS USED FOR DRINKING AND OTHER DOMESTIC PURPOSES.

Whatever can serve for the purpose just named cannot but be highly acceptable at a time when the question of water supply, purity of water, and the origin therein of substances deemed by some injurious, and indicating its contamination with the products of the decomposition of animal matter, is daily discussed. It is not our intention to enter upon speculative ground, but we will simply place before our readers a few facts, relating to the natural history of various kinds of water investigated by the Royal Committee appointed for the purpose of making a thorough inquiry into all matters relating to potable waters, and those used for domestic purposes, in the kingdom of the Netherlands, which facts, including chemical analysis, microscopic investigation of sediments, engineering, and geological matters, have been embodied in a printed report. We have selected those samples of water which, for their peculiarities in some respect or other, are best fit to bear especially also upon the question *how* and *whence* ammonia and nitrates, as met with in natural waters, are derived.

We have to call attention first to some facts which are, especially in this country, rather overlooked; to wit—(1) that, although the larger portion of the Netherlands territory in Europe is of comparatively very recent geological formation and consists of strata of very great permeability for water, that permeability exists in almost all kinds of geological formations, and, therefore, in all countries, hence the water of rivers, lakes, sea and other water-courses penetrates, to greater or less extent and depth, into the soil and contributes with the water fallen as rain and snow to fill the springs and more or less deep wells.

The second observation relates to an essential difference in the primitive source of the water of the British rivers as compared with, for instance, that of the Rhine; for the sake of illustrating what we mean, we will just briefly quote a few facts and figures, first about the Rhine, and next about the Thames. The Rhine has its sources in that portion of the Swiss Alps called the St. Gothard group, at an elevation above sea level of 9,967 feet; it is fed by the constantly melting ice and snow of the higher peaks of the Alps, and its three main constituent rivulets flow into one at Reichenau, at a height of 2021 feet above sea level; thence to the lake of Constanz or Bodensee the river takes its course over a hard, rocky bed; it traverses the lake just named, which, by-the-by, is exceedingly deep, and contains water of great purity. The direct course of the Rhine has a length of 415 miles, its basin has an area of 65,280 square miles, and its tributaries, large and small, number fully 12,000.

The Thames, although not the largest of British rivers, is, undoubtedly, the most important in many aspects beside commercial; it takes its origin from some rather insignificant brooks and rivulets near Cirencester; at Thames Head Bridge its level is 376 feet above that of the sea; its direct course to the Nore is 124 miles, and the area of its basin is 6,160 square miles. What is, however, of far more importance in this comparison of these rivers for our purpose, is the fact that, throughout its entire course, and especially previous to the point of bifurcation, the waters of the Rhine essentially retain that purity which gave rise to its being named in Switzerland, "*Reiner*" (purity). Dr. Von Planta Reichenau, an eminent Swiss *savant*, and the owner of large estates on and near the sources of the Rhine, has analysed its waters, taken at different seasons of the year and at different places of the course of this river, from Reichenau downwards to Emmerich, and has found that, what is in a very high degree the case with these waters at their primitive source, is retained in a very marked measure over this entire length of the river's course, viz., that the water always contains, dissolved, a large and abundant quantity of oxygen: this, coupled with the fact that the large bulk of the water of this river is not, to any great extent, modified by the water of its tributaries, some of which are large streams also taking their origin in ice and s
may have some bearing upon the very small a
of organic matter and the infinitesim
of ammonia met with in the water

Sufficient has been said to poin

a primitive and essential difference between the sources of the supply of water of the Thames and Rhine to account for more impurity in the latter, while, moreover, the value of manure of all kinds is too greatly esteemed along the mayor portion of the course of the Rhine to allow fæcal matters and other refuse and offal to find its way into a river, the police of which, or, rather, *administration de la sureté publique*, about which is under the control, not of one state, but of that of France, Baden, Bavaria, Hesse-Darmstadt, Prussia, and the Netherlands, jointly, whereby proper care is also taken as regards the fouling of the river and the pollution of its waters. Except in the Netherlands, and excepting also the men who, while navigating the Rhine or its tributaries, drink of its waters, that water is not used for drinking purposes by the great bulk of the large population dwelling on the banks of that river, since excellent water of easier access than that of the river is readily to be had. The writer of this article had, last year, while in Germany, an opportunity of obtaining some information about the supply of water, quantity, and quality, in use by the large numbers of soldiers at Coblentz, Cologne, Wiesbaden, and other places; great care has been taken to insure a constantly plentiful supply, and, above all, of good quality, by boring deep wells. Notwithstanding, the river water is excellent to the taste, rather less saline, however, and is certainly better for washing purposes, neither the military nor civil population of the places just named, and others situated along the Rhine, Moselle, Lahn, Maine, &c., ever think of using the water of these rivers, which, in many instances, indeed, they would have to fetch at a comparatively great distance from their dwellings. The writer was also informed that the water obtained from the public pumps, pants, and fountains, was regularly submitted to analysis, and that the authorities took great care to keep wells, and tubing, and all works in proper repair, so as to insure good and wholesome water.

Turning now to our chief subject, we quote, in the first place, the results of analysis, and other particulars of the water of a canal at Zwolle. This canal is so connected with the Zuyder Zee and tidal rivers that its level, by the effect of the flood and ebb, varies about 13 inches daily; the water was clear, pale yellow coloured, its taste somewhat similar to rain-water; on standing, it deposited a sediment, which, on being submitted to microscopic research, proved to contain not only minutely divided mineral matter, but also various infusoria, remnants of partially peatised vegetables, and small molluscs.

The result of the chemical analysis in this, as in every following instance, refers to *one* litre of the water, and the quantities are expressed in grammes—Total solid residue, 0·181; organic matter, 0·020; sulphate of lime, 0·0087; carbonate of lime, 0·0008; alkalies, 0·066, consisting chiefly of chlorides without any sulphates; ammonia, 0·00023; nitrates or nitrites, none; colour of dry residue, yellow before ignition, grey after. This water is not liked for drinking or domestic purposes, but occasionally used.

Water from a Pump at Groningen.—The well supplying this water is in very permeable soil; from the surface to a depth of 2·7 metres, layers of peaty soil are found; next follow sand and gravel. At 3·5 metres distance from the pump, an open sewer—a dirty ditch—runs. The water of the well is undoubtedly partly surface-water. Its physical properties are—Dark yellow colour; somewhat milky turbidity; taste not disagreeable, but very vapid. The microscopical examination of the sediment led to no other result than that structureless membranes were seen, which disappeared when a single drop of dilute hydrochloric acid was added, causing, at the same time, effervescence. Analysis yielded the following results:—Total sold residue, 1·386; organic matter, 0·225; sulphate of lime, 0·1094; carbonate of lime, 0·6556; alkalies, 0·396, consisting chiefly of chlorides without any sulphates; ammonia, 0·00790; nitrates, or nitrites none; colour of dry residue before ignition, brown; after, black. Almost all who reside in the neighbourhood where this pump is placed detest the water; it is only used after having been left quietly standing for at least twenty-four hours, and then only after having been boiled and cooled again. At the time the water was taken for analysis, much rain had fallen The city of Groningen is situated at a considerable height above sea-level, as compared with many other places of the kingdom.

Water taken from a Brook situated near Leeuwarden, in the Alluvial Soil of the sea formerly existing there.—The bottom of this brook consists, for about 2 metres depth, of a layer of partly-decayed fresh-water plants. At about 150 metres distance from the brook, a large dung-heap is permanently placed. Physical properties of this water—Nearly colourless; quite limpid; tastes like rain-water. After long standing, a very slight sediment is deposited, which, on microscopic investigation, was found to consist of very small molecules, and flocculent vegetable matter, containing the very lowest order of infusoria. Result of chemical analysis—Total solid residue, 0·5135 gramme per litre; organic matter, 0·0675; sulphate of lime, 0·0583; carbonate of lime, 0·2617; alkalies, 0·126, chiefly chlorides without any sulphates; no ammonia, and only very faint traces of nitrates; colour of residue before ignition, yellow; after, greyish black. This water is largely used by the inhabitants, and very well liked. At the time the water was taken for analysis, not much rain had fallen. The level of the water in this brook is 47 centimetres below A. P.,* which is about sea-level.

Water from a Pump at Dokkum.—This pump is placed on a now disused cemetery. The water is collected in an underground vault made of masonry. The level of the water is 2·45 metres below the surface of the pavement, and is evidently also fed by a canal which is situated at about 100 metres distance from the vault. No sewers are anywhere in the neighbourhood; but close to the pump is a building used as a schoolhouse, and this place being unprovided with an urinal, the boys (200 in number) are in the habit of making their water outside the school, against the wall, in consequence whereof the soil in the immediate vicinity of the pump is saturated with urine. The water is about colourless, clear, and limpid, and not at all disagreeable to the taste. A sediment subsides after some time; and this, on being investigated with the microscope, was found to contain molecules of clay, very small vegetable seeds, and pieces of threads of white wool and blue cotton. Total solid residue, 1·6935; organic matter, 0·1550; sulphate of lime, 0·4669; carbonate of lime, 0·2831; alkalies, 0·7885, chiefly chlorides without any sulphates; no ammonia; no nitrates or nitrites; residue yellow before ignition, grey after. This water

* A. P. stands for *Amsterdamsch Peil*, which is the starting point, or zero, from which all levels below or above are measured in Holland. This true and very accurately-determined point was first adopted at Amsterdam about the year 1680; and, after having been verified over and over again, has been, since 1818, adopted as the general zero of all levels in the country.

is not much used, except by the schoolboys. At the time the sample was taken for analysis, there had been a good deal of rainfall.

Water from a Canal called the Dedemsvaart, Province of Overijssel.—This water is derived from the extensive peat bogs, to which the canal gives ready access. Its colour is as dark as sherry, but it is limpid and clear; taste vapid and disagreeable. The sediment which subsides exhibits, when viewed under the microscope, a multitude of peatified vegetable substances and infusoria. Total solid residue, 0·131; organic matter, 0·080; sulphate of lime, 0·0146; carbonate of lime, 0·02854; alkalies, 0·021; no sulphates; ammonia, 0·00041; of nitrates rather a large quantity; residue brown, black after ignition. While burning, it gives off an odour resembling that of smouldering nitrogenized organic matter. No rain had fallen for several days when the sample of water for analysis was taken. This water is not used for drinking or domestic purposes.

Water from a Pump surnamed the "Staten Pump," at the Hague.—This pump is placed close to one of the most ancient buildings in the said town, and stands on a comparatively high level. The level of the water in the well is about 5 metres below the pavement. A thin brick wall only separates this pump and well from an extremely foul and dirty canal, a rather large open sewer, which winds its course to a large canal named "Spui." The water is rather turbid; does not become clear on standing; exhibits a yellowish colour; taste saline; no microscopic investigation. Total solid residue, 0·750; organic matter, 0·060; sulphate of lime, 0·0639; carbonate of lime, 0·1831; alkalies, 0·443; no sulphates of alkalies; ammonia, 0·01181; large quantity of nitrates; colour of residue before ignition yellow, after ignition grey. This water is largely used, and relished by those who reside near enough to make it worth their while to fetch it.

Water from a Pump situated in the Cité Ouvrière belonging to M. Régout, at Maestricht.—This pump is of comparatively recent construction, is in good working order, and the well is built in by means of brickwork laid in strong hydraulic cement; a canal is at 159 metres distance. No infiltration of surface water, nor of the contents of a large underground sewage cistern, has been found to exist. The water is of excellent quality, quite clear, colourless, and pleasant to the taste. Total solid residue, 0·650; organic matter, 0·020; sulphate of lime, 0·043; carbonate of lime, 0·342; alkalies, chiefly as chlorides, 0·245; no sulphates of alkalies; no ammonia; no nitrates nor nitrites. The soil in and about Maestricht is full of fossils, and noted for having been the place where very interesting animal remains have been found, while, moreover, the town, in consequence of having been since at least three centuries a fortress, and having frequently been besieged for months together, is, in a sense, a vast cemetery, full of the human remains of soldiers killed during such sieges and interred within the town, which, however, is of large extent of surface. Colour of solid residue of water before ignition, pale brown; after ignition, greyish black. The water is largely used, and very much praised and relished.

Rain-water Collected at St. Annaland, Province of Zeeland, at no great distance from the Sea.—The water was taken from a large, well-made, underground cistern, used for storing the water, built of bricks and strong cement; the water, on falling on a tiled roof, is led by means of wooden spouts to the cistern, which is surrounded by sand and clay soil; the water was slightly coloured, somewhat turbid, but does not deposit a sediment; taste, the same as is usually experienced from rain-water. Total solid residue, 0·4775; organic matter, 0·055; sulphate of lime, 0·136; alkaline chlorides, 0·2085; alkaline sulphates, 0·004; no ammonia; a very faint trace only of nitrates; colour of residue, before ignition, pale yellow; after ignition, pale grey. The water is much used, since there is no other but brackish water, quite unfit for any use.

Water taken in the Middle of the River Merwede (a local name given to a portion of the Rhine after the river Maas has joined it near Woudrichem).—Off the town of Dordt, the river is at this point about 1200 metres wide, and rather deep. The water was taken about the middle of the month of March last year. The water was very turbid, did not become clear on standing, and its taste was disagreeable. Total solid residue, 0·160; organic matter, 0·040; sulphate of lime, 0·0355; carbonate of lime, 0·420; alkalies, chiefly chlorides, 0·0425; sulphates of alkalies, none; ammonia, none; of nitrates, a faint trace; colour of solid residue, before ignition, pale yellow; after, pale greyish. This water is largely used, but in many households it is filtered previously.

Water from a Well bored, in 1866, at the Hague, for the private use of a Manufactory.—Total depth of boring, 5·65 metres, passing through 1·05 metre of sand; 0·40 metre of blackish peaty soil; 1·0 metre pure peat bog; 0·70 metre sand and peaty veins; 1·50 metre bluish-coloured sand; 1 metre white-coloured sand mixed with shells of molluscs; the water leaves 0·704 gramme to the litre of solid residue dried at 120° C.; organic matter, 0·198; carbonates of lime and magnesia, 0·192; chloride of sodium, 0·247; sulphuric acid, 0·206 gramme to the litre; no ammonia, and no nitrates nor nitrites have been detected in this water, although diligently sought for in a large quantity of water carefully evaporated to small bulk; the water is not colourless, but excellent to the taste, and the supply very abundant.

Results of the Analysis of Three Varieties of Water, obtained at Rotterdam by Means of Norton's Well Tube, driven into a Layer of Whitish coloured Sand.—No. 1 well is 23 metres deep below sea level; No. 2 well has the same depth; No. 3 is about 14 metres below sea level. The physical qualities of these waters are good; the water has risen within the tube to about 1 metre below the surface of the mouth of the tube, which is level with the soil wherein it is driven.

	I.	II.	III.
Total solid residue	0·708	0·320	0·448
Organic matter	0 146	0·094	0·094
Carbonates of lime and magnesia	0·204	0·068	0·170
Chloride of sodium	0·098	0 029	0·093
Sulphates, calculated as SO_4	—	0 C04	—
Ammonia	0·021	0·020	0·011
Nitrates	Decided reaction.	Decided reaction.	Very strong reaction.

The analyses of the few samples of water selected for quotation from upwards of 300 analyses published in the report, represent the varieties of water used for domestic purposes in the Netherlands; to wit, rain-water, river-water, water from brooks and canals, water taken from more or less deep wells, sunk or bored, into the ground to more or less depth, but never reaching to

layers of very solid, and never to what should be properly called rocky, material. The localities selected are situated many miles distant from each other. As regards the alkalies, potassa and soda, it should be observed, that while generally no sulphates of the same are met with, a portion of these substances is very frequently combined in the waters analysed with humic, ulmic, crenic, and apocrenic acids and other organic substances. The composition of the water of the great rivers, passing through the country, does not materially differ at any point of their course as long as that water remains potable, from not being within sea reach, when the samples are taken at the same period of the year.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.*

BY LIEUT. J. HERSCHEL.

This letter, written from Bangalore, states that the author discovered a new line in the spectrum of the sun's rays, in the neighbourhood of G; the author determined its position without difficulty, with reference to the rest of that crowded group of solar lines, and found it identical with the thick line at 2796 of Kirchhoff's chart; while studying this newly-discovered line, the writer succeeded in distinctly seeing a fainter red flash, already described by Mr. Lockyer, and he also noticed another line (the 6th) between F and G. These lines are defined by the figures of the Greek alphabet, and their number and position indicated according to Kirchhoff's chart. The letter then enters into details of mode of observation, and proceeds to discuss an article by Mr. Huggins in the *Quarterly Journal of Science*. This part of the letter, however, is not suitable for abstraction.

ON SOME GENERIC REACTIONS IN ORGANIC CHEMISTRY.

BY S. E. PHILLIPS.

Organic chemistry has been variously defined: I would represent it as essentially "the chemistry of generic reactions."

It is mooted that a fuller recognition, and a more systematic study of a few widely-generic reactions, may do much to bring about a more simple outline classification of the vast wonders of organic combinations.

These reactions have been recognised in their simplest expressions; but it has not been so clearly shown that they extend into regions of great intricacy, where the guidance of law is so much needed in the discrimination of complex types of combination.

Astronomy and geology have aspects of immensity which engage and entrance the noblest powers of human intellect, nor is chemistry in any way inferior as another receding horizon of infinity.

These aspects are, indeed, the inverse of dissolving views, for it is the reward of genius, of labour, and sacrifice, to decipher, out of the dim chaos, minarets and pinnacles of architectural beauty, which entrance the mind and afford a pleasure that never satiates; and every line traced adds a new lustre, and a richer meaning, to those already drawn.

Moral and physical truth have a distinction only in a human or circumferential sense. All aspects of divinity coalesce and commingle towards an effulgent centre of infinite harmony; hence poets have been co-labourers with our profoundest philosophers and physicists in promoting the conviction that—

> "Discord is harmony ill-understood;
> All partial evil, universal good."

In offering these thoughts as an amateur, in presence of men whose abilities and means of investigation are greatly superior, some apology or explanation may be desirable.

The sincere desire is to write in a humble spirit of enquiry, rather than of dictation.

It is true that most English chemists have adopted the new notations; but, seeing that in the continental journals fully one-half the articles are written in old style, and that so great an authority as Dumas does not hesitate to express entire inability to read modern chemical memoirs, owing to their complex types and "barbarous" nomenclature, surely it may be forgiven in an unpretending student to express long-pent-up thoughts in what appears to him as the clearest and simplest language, the more so as his object is purely to ventilate principles (which are independent of modes of representation), and also to challenge students of the modern ways, to see if they can penetrate deeper or see further into the wonderful labyrinth.

The pretentious methods of modern notation are certainly curious in their way; and it is refreshing to see the tone of sober-minded reaction which has been evinced at the recent discussions of the Chemical Society.

One of the most prominent facts of general chemistry is that hydrides are "indifferent bodies"—they do not combine without decomposition—yet Professors Hofmann and Wanklyn see in these prolific sources of substitution, and even of direct dedoublement; they are prominent in the diamines and triamines of the former, and to the latter they are leading types to which other definite chemical combining bodies may be referred:—

Ethylene. $C_4\begin{cases}H\\H\\H\\H\end{cases}$ Hydride of ethyl. $C_4\begin{cases}H\\H\\H\\H\\H\\H\end{cases}$

Rosaniline. $C_4\begin{cases}NHC_{12}H_5\\NHC_{12}H_5\\NHC_{12}H_5\\H\end{cases}$ Leucaniline. $C_4\begin{cases}NHC_{12}H_5\\NHC_{12}H_5\\NHC_{12}H_5\\H\\H\\H\end{cases}$

M. L. Henry holds that salicylic alcohol is an *aldehyde* as well as a *phenol*, and that by chloro-variation it gives the following series:—

Salicylic alcohol, $C_6H_4<^{HO}_{CHO}$

Doubly-chloruretted cresol, $C_6H_4<^{HO}_{CHCl_2}$

Triply-chloruretted toluol, $C_6H_4<^{Cl}_{CHCl_2}$

Chloruretted aldehyde of salicyl, $C_6H_4<^{Cl}_{CHO}$

Whether the first really be an alcohol, or the last an

* Abstract of a letter addressed by the Author to W. Huggins, F.R.S., and communicated by him to the Royal Society.

aldehyde, is by no means certain, or even apparent, so random are these type-building speculations. And it seems strangely overlooked that the old radical theory is, peradventure, adequate to explain all these substitutions without any such paradoxical nomenclature.

The first pair, as *hydrides*, would be—

$(C_{14}H_5O_4),H$ and $(C_{14}H_5O_2),H$;

the second pair are evidently chlorides—

$(C_{14}H_5Cl_2),Cl$ and $(C_{14}H_5Cl_2O_2),Cl$;

as *alcohols* the first pair would be—

$(C_{14}H_5O_2)O+HO$ and $(C_{14}H_5Cl_2)O+HO$

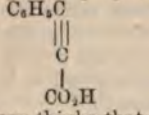
Another authority, speaking of an acid derivative of mesitylen, $C_{18}H_{11}H$, says $C_9H_6O_6-3CO_2=C_6H_6$, therefore it is a benzol with 3(COHO), substituting 3H!

In order to parallel the cogency of this logic, I would say of the thousands or millions of organic bodies which similarly break up into oxalic acid, that, therefore, they are oxalic acid with the infinity of residues replacing, &c., &c.

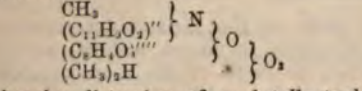
M. Schorlemmer, before the Royal Society (CHEM. NEWS, vol. xix., p. 196, *Am. Reprint, June*, '69, *p.* 303), says, the oxidation products of propylic glycol are carbon dioxide, and acetic acid, which proves that the structure of the glycol is expressed by the formula $CH_3—CH(OH)—CH_2OH$.

Another authority, with like wonderful prevision, says that hydrocinnamic acid is $C_6H_6+CH_2—CH_2—COHO$, and the saltic type is $(C_9H_9O_2)_2Ca+1\frac{1}{2}H_2O$.

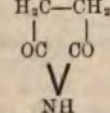
Another insists that the acid, with 2H less than cinnamic acid, $C_{18}H_7O_2+HO$, and therefore $C_{18}H_9O_3+HO$, coumaric acid, is phenyl-propiolic acid—



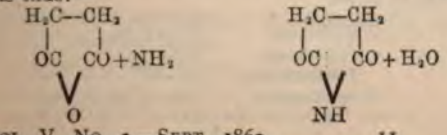
Professor A. Matthiessen thinks that all the reactions of narcotine may be accounted for by the following rational (?) formula:—



By a singular distortion of an intellectual process, some have thought that the simple principles of mineral chemistry might be employed to gradually unravel the greater complexities of organic combination. Professor Wanklyn has corrected this error, and shown that, in the simple salts and hydrates of soda, lie hidden the mysteries of triatomic and septatomic quantivalence: we must not go from the simple to the complex, but rather work out principles or fantasies from organic chemistry, and then apply them to the old binary compounds of mineral chemistry. Time was when the relation of acid to amide was a matter of great simplicity, but M. Erlenmeyer now sees much farther. Succinimide is—



and its origin from anhydrous succinic acid and ammonia is thus:—



To give but a faint description of these modern pleasantries of atomic mechanism would fill large volumes. We can only add in this brief glance, that they are from men of undoubted eminence and great practical ability.

Enough has been said to justify our hesitation in adopting any of these multifarious modes, and in the pressing desiderata to lay hold of some wide generic principles which may afford some comprehensive grasp of the whole contour of organic metamorphosis; we humbly, and *pro tem.*, fall back on the old binary principles of Berzelian and Lavoisierian chemistry, as best fitted for the widest and most comprehensive grasp.

We assume, until a wider and better theory can be offered, that such radicals as methyl (C_2H_3), ethyl (C_4H_5), propyl (C_6H_7), acetyl (C_4H_3), and a vast infinity of analogues do exist, and that, as hydrides, they are characteristic indifferent bodies, while with O, Cl, S, and other negative elements they form bases or acids, and other more neutral bodies, perfectly paralleled by the more simple elements of mineral chemistry.

The confidence and dogmatism with which such types and names as we have indicated are obtruded upon notice will be in no way imitated. We shall try to lay hold of leading types, ever bearing in mind that they must necessarily be subject to manifold ways of isomeric variation. The ground to occupy is of too wide and extensive a character to permit of special exactitude; but this attitude should in no way be opposed to rigid scrutiny or microscopic investigation at any stage of the process. The harvest is indeed ripe, and manifold labourers are wanted in every direction; workers in the laboratory and watchers of the wide horizon. Our meaning in this direction will perhaps be better understood by an illustration.

We deem, then, the term phenyl-propiolic acid almost as barbarous as the older term, "sulphuric ether." Now that we have an infinity of ethers, including a true sulphuric ether, it surely behoves us to carefully control their nomenclature.

In what way the radicals phenyl and propyl may combine to form the acid in question is a legitimate matter of detail, nor can we afford to wait long upon such minutiæ. To us the great question is, Is there a hydro-carbon radical ($C_{18}H_5$) comparable with acetyl (C_4H_3), or cinnamyl ($C_{18}H_7$), &c., &c.?

Our meaning may further be seen in regard to the body aceton, $C_6H_6O_2$. Its origin and subsequent reactions led very generally to the idea of its being a hydride of acetyl, $C_4H_3O_2,H$, in which the H was replaced by the gaseous methyl (C_2H_3) = $C_4H_3O_2,C_2H_3$.

While recognising the validity and value of this aspect as one of the elements of isomeric variation, yet would we stoutly urge the great necessity for a due subordination of this phase of organic combination. To give it undue prominence, as is too often done, and coin a shibboleth of hard names, is positively confusing and detrimental.

It has only just transpired that, by the simple and direct oxidation of the hydrocarbon propane or hydride of propyl, we get a body possessing all the characters of acetone, $C_6H_6O_2,H$.

The distinction between the two types is one of great importance, because the hydrocarbons proper are comparatively few and capable of a simple generic classification, while such types as acetone, $C_4H_3O_2,C_2H_3$, are capable of an infinite variation, nor do I see any hope of embracing them in any generic arrangement.

[English Edition, Vol. XX., No. 505, pages 49, 50.]

It only remains in this short introduction to offer a few thoughts as to why we still adhere to the old notation in regard to O, S, C, and other doubled atoms of modern theory.

Among other reasons, O is doubled because its ordinary volume is half that of H. The same anomaly subsists in the volumetric character of the phosphorus, arsenic group, and some have pushed theory so far as even to double these, but that is generally discountenanced on the ground that the anomaly disappears in their various compounds, where the volumes agree with the atomic weights in a way perfectly comparable with the one volume, N.

			Density.	Atomic Weight.
Ammonia....	H_3N	2 vols.	17	17
Phosphonia ...	H_3P	"	34	34
	&c., &c.			

We moot that the same argument is strictly applicable for oxygen also.

It is monatomic and replaces chlorine, &c., in organic radicals where the volumes correspond normally; in other words, the densities are as the atomic weights.

			Density.	Atomic Weight.
Hydride of acetyl	$(C_4H_3O_2)H$	2 vols.	22·04"	44
	$(C_4H_3Cl_2)H$	" "	49·70"	99
	&c., &c.			

Hydrides are normally two vols., whence their densities are half their atomic weights, but these radicals themselves are normally one vol., and their densities exactly correspond with the atomic weights.

		Density.	Atomic Weight.
H.....	1 vol.	1	1
$(C_4H_3O_2)$....	"	43	43
$(C_4H_3Cl_2)$....	"	98	98
	&c., &c.		

Also in organic acids the densities and atomic weights agree in innumerable cases of proto-, sesqui-, bi-, and tri-acid forms where chlorine and oxygen are perfectly paralleled.

Again, oxygen, in conjunction with C = 6, and S = 16, replaces H in ammoniacal types, and here also the densities and atomic weights agree.

		H_3N		Density.	Atomic Weight.
Ammonia.....		HH_2,N	2 vols.	8·5"	17
Ethyl mustard oil		$(C_4H_5)(CS)_2,N$	"	43·7"	87
Methyl	"	$(C_2H_3)(CS)_2,N$	"	37·8	73
Amyl	"	$(C_{10}H_{11})(CS)_2,N$	"	63·4	129
Butyl	"	$(C_8H_9)(CS)_2,N$			
		&c., &c.			

and, by a generic action, these, by addition of ammonia, form fluosinnamin types of sulph-ureas.

Urea.....	$H(CO)_2H_3N_2$
Fluosinnamin.....	$(C_6H_5)(CS)_2H_3,N_2$
Butyl sinnamin.....	$(C_8H_9)(CS)_2H_3,N_2$
&c., &c.	

Lastly. Monatomic oxygen replaces H in the general phenomena of substitution, mainly like chlorine.

The oxidations, chlorodations, and sulphodation of carbydrogens, rich in hydrogen, present a unity of action; and the bases split up to negative or acid forms, by similar intermediate stages of hydride or indefinite bodies, where O=8; S, 16; and Cl, 35·5, replace each other with volumes and atomic weights in perfect harmony.

We now take a glance at the amide and glucoside modes of production.

Amides.

The study of these bodies some years ago afforded the writer great interest:—

1. As possessing such new and varied phases of ammoniacal type.

2. As proving the adequacy of plain and simple principles to guide without ambiguity or mystification into the profound depths of the science.

3. As proving that *one generic formula of reaction* or production seems to give amides, hydramides, ureides, or ureas, amide acids, urethanes, &c., &c.

4. As proving the strongest arguments against the modern doctrines of mono-, bi-, and tri-basic acids, and the similar mono-, bi-, and tri-amines.

In this connection I can only refer to one aspect of this wide field, viz., its tendency to resolve hitherto unexplained groups of organic combination. If I mention two such groups it is not so much because success appears to attend the very onset, as to elicit a co-operative or corrective criticism.

On the one hand, I have long felt puzzled at the existence of an apparently aberrant group of carbohydrogens with even instead of odd ratios of H, and have marked out for investigation what may, perhaps, be called *the malic acid group.*

This group is exceptional in the even number of H atoms in the radical, whereas all other acid series have only odd numbers of H. A special study of this group might throw some light on the problem why all the carbon constituents have even numbers, and the H part odd numbers, while the oxygen seems normally to affect even numbers in the radical.

The first step in the process is evidently to apply the generic formula in question, and the peculiarity seems to stand that test, for

Malate of A—2HO gives Malamide.. .....$(C_4H_2O_2)H_2N$
Bimalate of A—2HO " Malamic Acid (Aspartic)..$2(C_4H_2O_2)H_2N,O$
Aspartate of A—2HO " Aspartamide (Asparagin)..$2(C_4H_2O_2)H_4N_2$

Most books say that malamide or asparagin is found in the asparagus, in marsh mallow, and some other plants, but, although of the same composition, they are not identical, and I think my notation and a recognition of the ureal or atmonia type of asparagine will clear up the difficulty. I cannot see the least reason or advantage in doubling this acid to make it square with the modern notion of bibasic acids.

In "Fownes" (9th edition), its structure and derivation is compared with that of the oxamide series. In both cases, the acids and neutral salts are doubled, while the acid salts (binacids ?) and their derived amides contain no more acid than the mono or neutral forms, and yet the prefix *bi* is retained.

I ought, perhaps, to have pointed out that, by an extension of the formula, when the acid is an ammoniacal one, then the result is an ureal amide, thus—

Carbamate of A—2HO=Urea.....$2(CO)H_4N_2$
Aspartate of A—2HO=Aspartamide (asparagin).....$2(C_4H_2O_2)H_4N_2$
&c., &c.

On the other hand, there seems a tolerably wide range of combination with unusual and intractable ratios of oxygen, and with little or no H in the compound, as in the

Mellitates,	$HO+C_4O_3$
Croconates,	$HO+C_5O_4$
Rhodizonates,	$HO+C_7O_7$
Saccharates,	$HO+C_6H_4O_7$
&c., &c.	

How, then, does this generic action apply to such cases?

Carbonate of	Ammonium	—2HO,	gives	Carbamide.
Bicarbonate of	"	"	"	Carbamic acid.
Oxalate of	"	"	"	Oxamide.
Binoxalate of	"	"	"	Oxamic acid.
Benzoate of	"	"	"	Benzamide.
Bibenzoate of	"	"	"	Benzamic acid.

$$H_4NO+CO_2-2HO=(CO)H_2N$$
$$H_4NO+2CO_2-2HO=2(CO)H_2N,O$$
$$H_4NO+C_2O_3-2HO=(C_2O_2)H_2N$$
$$H_4NO+2(C_2O_3)-2HO=2(C_2O_2)H_2N,O$$
$$H_4NO+C_{14}H_5O_3-2HO=(C_{14}H_5O_2)H_2N$$
$$H_4NO+2(C_{14}H_5O_3)-2HO=2(C_{14}H_5O_2)H_2N,O$$
&c., &c.

The infinity of amides thus produced are hydride, indifferent or non-combining bodies, mostly affecting the crystalline form of needles, and insoluble; in all probability they are of the type H_2N,H. Whatever ammonia is in type, constitution, and general properties, that, in all probability, are the amides.

The amic acids are ammoniums, H_4N,O, definite combining bodies, and de-doubling with basic, intermediate, or acid functions just in proportion as the substitutional equivalents rank higher or lower in the electro series.

Malate of	Ammonium	—2HO	gives	Malamide.
Bi-malate of	"	—2HO	"	Malamic (aspartic) acid.
Succinate of	"	—2HO	"	Succinnamide.
Bi-succinate of	"	—2HO	"	Succinnamic acid.
		&c., &c.		

It is curious to compare these simple and consistent notations with the confused variations of modern theory. Any fundamental appeal to the guidance of law is wholly lost in the doubling of atoms, and the varied estimates of water of hydration in the several compounds submitted to the amide formula.

In extending this list considerably, I am well aware there are chemical reasons for doubling the atom in some cases where, indeed, that process may, in all probability, be necessitated: I only contend that this should be done with extreme caution, and not without a survey of the several relations.

As to the doubling of succinic acid, I find the following remark in my rough notes:—"M. Fehling, and also M. Cahours, seem quite sure that succinic acid is tribasic, like the phosphates $3HO+C_8H_3O_5$; and, between the chemical reasons urged by the bi- and tri-basic claimants, I could not see a pin's difference whereon to found a preference; but, where all is so empirical, the simple truth may have a strong advocate in M. Dopling, from whose elaborate paper I copy an extended series of succinates ($MO+C_4H_2O_3$), with the usual variation of type in ascending the series into the weaker bases, where two and three atoms of base are found, as in the corresponding acetates, sulphates, &c."

Many salts affect two volumes, but there are several whose densities are as one volume, as in the

Succinate of ethyl, $EO+C_4H_2O_3$,
Succinate of methyl, $MeO+C_4H_2O_3$,
Oxalate of ethyl, $EO+C_2O_3$,
Silicate of ethyl, $EO+SiO_2$,
Oenanthate of ethyl, $EO+C_{14}H_{13}O_3$,

and others.

The theoretical application of this formula to the second group would be thus—

Mellitate of A—2HO=Mellitamide?
Bi-mellitate of A—2HO=Mellitamic acid?
$$H_4NO+C_4O_3-2HO=(C_4O_2)H_2N\,?$$
$$H_4NO+2(C_4O_3)-2HO=2(C_4O_2)H_2N\,?$$

There is encouragement to think that these bodies may be obtained when duly sought for. Fownes says, "Mellitate of A yields, by distillation, two curious compounds—paramide, a white, amorphous, insoluble substance, containing C_8HNO_4 (*i.e.*, bimellitate of ammonia —4HO), and convertible, by boiling with water, into bimellitate of ammonia;" and euchronic acid, a colourless, soluble, crystalline body, containing, in the anhydrous state, $C_{12}NO_6,2HO$.

In this case, it is almost certain that paramide is the amide or ammonia form of mellitamic acid, evincing as it does the widely generic property of re-conversion, by boiling water, into bimellitate of A.

Here, then, we get a new substitutional representative of H; and, if one H can be replaced by (CO), (C_2O_2), or (C_4O_2), surely that does not end the series; and have we not more complex acids which may be explained by a similar process, and their radicals identified?

And, seeing that silicium is now so close a congener with carbon, may not a similar extension of law be applicable in the infinitely varied silicates of mineralogy?

Euchronic acid appears to be a varied mellitamic acid—thus, $3(C_4O_2)HN,O$.

Glucosides.

The manuals of chemistry present a strange variety of types in regard to the constitution of the sugars, and also complex acids containing higher ratios of oxygen; but there are considerations which seem to encourage the hope that both these intractable groups may, ere long, be embraced within the limits of simple law.

The hypothesis herein is twofold; 1st, That glycols, glycerines, mannites, and sugars are all monatomic alcohols; 2nd, That complex organic acids with high ratios of oxygen are substitutional variations of simpler types.

For a fuller exposition of these views, I must refer to a separate article on the constitution of the alcohols; but, for brevity, I here append a note on the aceto-nitrates, or, as I should prefer to call them,

Nitro-Acetates.

It is said that these belong to the water type $\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}\Theta_6$, in which H_6 is replaced by ferricum $Ffe^{vi.}$, and 1H is replaced by $(N\Theta_2)$

No. 1.
$$\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}\Theta_6$$
Type.

No. 2.
$$\left.\begin{matrix}Ffe^{vi.}\\H_6\end{matrix}\right\}\Theta_6+2H_2\Theta_2$$
Normal ferric hydrate.

No. 3.
$$\left.\begin{matrix}Ffe^{vi.}\\4(C_2H_3\Theta)'\\(N\Theta_2)'\end{matrix}\right\}\Theta_6+4H_2\Theta$$
Tetra-aceto-nitrate of iron.

No. 4.
$$\left.\begin{matrix}Ffe^{vi.}\\3(C_2H_3\Theta)'\\(NH_2)'\\H_2\end{matrix}\right\}\Theta_6+2H_2O$$
Trio-aceto-nitrate of iron.

No. 5.
$$\left.\begin{matrix}Sr''\\(C_2H_3\Theta)'\\(N\Theta_2)'\end{matrix}\right\}\Theta_2$$
Aceto-nitrate of strontian.

No. 6.
$$\left.\begin{matrix}Ba''\\(C_2H_3O)'\\(N\Theta_2)'\end{matrix}\right\}\Theta_2$$
Aceto-nitrate of barium.

If, in these compounds, (NO_4) really replaces 1H of acetic acid, and, further, presuming that, in the three and four atoms of acetic acid, only one atom is so modified, then the formulæ might be thus—

$$\left.\begin{matrix}\text{(No. 6). } 2BaO+AcO_3,HO\\\text{(No. 5). } 2SrO+AcO_3,HO\end{matrix}\right\}AcO=C_4H_2(NO_4),O_2$$
$$\left.\begin{matrix}\text{(No. 4). } 2Fe_2O_3+3AcO_3,7HO\\\text{(No. 3). } 2Fe_2O_3+4AcO_3,HO\end{matrix}\right\}1AcO=C_4H_2(NO_4),O_2$$

It only remains to compare these notations with the ordinary types of similar true acetates; and methinks all seems quite fair and simple; nothing strained, nothing outlandish. No new principles, no 6-atom water types are at all requisite! As to the 6-atom *normal* ferric hydrate, it is clearly $3HO+Fe_2O_3$.

What is this ferricum if it be not 2 atoms of ferrosum? and yet this latter is said to be tetratomic, while the former is hexatomic!

Ferrosum=Fe^{iv}·=(56). Ferricum=Ffe^{vi}·=(112). As a general rule in such cases of substitutional variation, I prefer to retain, if possible, the supposed normal type, with a dash referring to a marginal explanation; also to retain the dash in cases where some unknown substitutional variation may be presumed.

Some vigorous effort is needed to restrain the amazing fecundity by which the multiplication of types and hard names have become a pest to the science.

				Sources.	Acid.					Base.				
1. Acetic Ether	C_8	H_8	O_4	—	Acetic acid	HO+	C_4	H_3	O_2	+ Alcohol	C_4	H_6	O_2	— 2HO
2. Stearine	42	42	8	Animal fats	Stearic acid	HO+	36	35	3	+ Glycerine	6	8	6	— 2HO
3. Bi "	78	76	9	" "	" "	HO+	72	69	5	+ "	6	8	6	— 4HO
4. Tri "	114	110	12	" "	" "	HO+	138	103	7	+ "	6	8	6	— 6HO
5. Salicine	28	18	14	Willow bark	Saliginine	HO+	14	7	3	+ Sugar	12	14	14	— 4HO
6. Populine	40	22	16	Aspen bark	—	HO+	28	11	5	+ "	"	"	"	— 4HO
7. Phloridzine	42	24	20	Cherry bark	Phloretine	HO+	30	13	9	+ "		"		— 4HO
8. Quercitrine	38	18	20	Quercitron bark	—	HO+	24	7	9	+ "		"		— 4HO
9. Esculine	42	24	26	Horsechesnut	Esculetine	HO+	18	5	7	+ 2 Sugar	2(	"	)	—10HO
10. Paviine		—		Ash bark	—	—		—		+ Sugar		"		—
11. Saponine		—		Soap wort	—	—		—		+ "		"		—
12. Frangulin	40	20	20	—	—	HO+	28	9	9	+ —		—		— 4HO
13. Piobaphen	52	24	28	—	Oak red	—		—				—		—
14. Cainein	48	39	21	Chiococca Ramosa	Chiococcin	HO+	36	27	9			—		— 2HO
15. Amygdalin		—		—	—	—		—				—		—
16. Rubian		—		Madder root	Alizarin?	—		—		+ Sugar		—		—
17. Indican		—		"Indigofera"	Indigo red?	—		—		+ "		—		—
18. Antiarine		—		"Antiaris"	Yellow resin	—		—		+ "		—		—
19. Murrayin	72	44	40	—	Murrayetin	HO+	48	23	19	+ 2 Sugar	2(12	12	12)	— 4HO

2 and 3.—It remains to be seen whether these substitutions take place in the acid or in the base—precedents are equally available for both cases; and this alternative applies to the whole series. The StO_3 of No. 3 would be—

$$\overbrace{C_{36}H_{34}(C_{36}H_{35}O_2)O_3},$$

that of No. 4 would be—

$$C_{36}H_{33}(C_{36}H_{35}O_2)_2O_3.$$

6.—The acid, 28 11 5, easily splits into benzoic acid, whence it may be that this acid is of type No. 5, with the radical of benzoic acid (14 5 2) replacing 1H.

7.—The acid, 30 13 9, splits into phloretic acid, HO+18 9 5, whence it may be that acid with 1 (12 5 4) replacing 1H. Phloridzine gives a characteristic ammonia phloridzeine, just as orcine gives a similar ammonia orceine; and I subsequently find orcine is associated with a lichen sugar!

18.—Antiarine is—C, 61·2; H, 8·1; O, 30·7. Its yellow resin is—C, 83·9; H, 9; O, 4·2.

These studies have afforded much pleasure in the prosecution; but, while our leading chemists are eagerly pursuing other routes, they are presented with diffidence and humility, in the hope that other minds may be induced to take stock of progress, and to enquire whither we are tending, and what are the materials elaborating in our workshops or laboratories for the popularisation of science.

PRELIMINARY NOTE ON NAMAQUALITE.

BY A. H. CHURCH, M.A.

Some time ago I obtained from Mr. J. R. Gregory a few pieces of a beautiful blue silky mineral which he had obtained during his recent visit to South Africa, from one of the copper miners of Namaqualand. The qualitative examination of the mineral proved it to contain copper, aluminium, and water, with traces of calcium, magnesium, and iron. Several specimens were crushed into fragments, and the pure homogeneous parts picked out for quantitative analysis. The percentage numbers correspond pretty closely with the formula $Al_2H_6O_6$, $3CuH_2O_2$,4aq.

The constitution of this mineral appears to warrant the bestowal of a specific name; the locality of its occurrence suggests that of *Namaqualite*. I am engaged in completing the investigation of the physical and chemical characters of this compound; but I may now mention that it occurs in thin layers made up of short silky fibres, and is of a pale blue colour. The layers alternate with another copper mineral, which is amorphous, and is probably chrysocolla. Namaqualite has something of the aspect and texture of a soft variety of crocidolite or of chrysotile. The absence of silica from namaqualite is remarkable. As far as at present made out, it would seem to be a cupric aluminic hydrate, hitherto unrecognised.

ON SOME MEANS FOR

PREVENTING THE BUMPING OF BOILING LIQUIDS.

BY HUGO MÜLLER, F.R.S.

The annoyance which arises from the bumping of certain liquids when submitted to distillation or boiling has often attracted the attention of chemists, and various means have been proposed for its prevention.

The value of pieces of platinum, charcoal, burnt clay, and other porous bodies for this purpose is well known, and, under certain circumstances, are efficient enough; yet there occur very frequently cases in the laboratory when these means are unavailable.

About two years ago Pietro Pellogio (*Fresenius, Zeitschr.*, vi. Jahrg.) proposed a very simple contrivance, which was stated to act very satisfactorily indeed. It consisted of a moderately wide glass tube, passing through the cork of the tubular of the retort, and nearly reaching the bottom of it, the upper end being bent at right angles and drawn out into a capillary tube.

Having occasion to try the efficiency of this arrangement, I came to the conclusion that it was quite inef-

fective, and shortly after, G. Hager (*Pharmac. Centralhalle*, Bd. 9) confirmed the negative results I obtained.

Quite recently E. Winkelhofer (*Ber. d. Chem. Gesellsch. Berlin*, p. 194, 1869) proposed for the same purpose the application of an electric current, which, through the incipient decomposition of the liquid and consequent evolution of gas, causes the ebullition to become quite regular and steady. Dufour, for another, with another object in view, had made use of the same means.

The application of the electric current unfortunately presupposes that the liquid to be distilled is a sufficiently good conductor of electricity; and, if this is not the case, necessitates the introduction of such substances as shall cause the liquid to become a conductor. This circumstance, therefore, limits very considerably the use of this otherwise efficient arrangement, and it is on this account that I venture to bring under notice some other means which I have tested in a variety of cases, and which invariably proved satisfactory.

In cases where the introduction of any foreign matter into the liquid about to be distilled is undesirable, I introduce through the cork in the tubular of the retort a glass tube, which is drawn out to a long capillary tube and pressed tightly to the bottom of the retort. The upper end of the glass tube is connected, by means of an india-rubber tube, with a generator of carbonic acid, or hydrogen, or a gas-holder containing air, and whilst the distillation is going on, one of these gases is passed in a slow but continuous current through the liquid. Under these conditions, all bumping is avoided, and the distillation proceeds with the utmost facility.

For ordinary purposes, however, I have found it still more convenient to introduce into the liquid about to be distilled a small fragment of sodium amalgam, or, in cases where the liquid is acid, a small piece of sodium-tin. Methylic alcohol is well known to be one of the most difficult liquids to distil, yet, on the introduction of a minute piece of sodium amalgam, or sodium-tin, it can be distilled without the slightest inconvenience. I found on one occasion that more than 400 grammes of methylic alcohol distilled over with perfect steadiness, and without exhausting the activity of a fragment of sodium-tin, weighing not more than 0·060 grms.

It is, perhaps, hardly necessary to mention that the action of sodium amalgam and sodium-tin is due to a minute but continuous disengagement of hydrogen taking place during the process of distillation.

UTILISATION OF BLAST FURNACE SLAG.*

In this paper the author endeavours to point out some of the uses to which this almost valueless material, which is produced in very large quantity in the manufacture of iron, may be applied. He states that slag is a compound containing an excess of lime, and produced by the siliceous and earthy matters contained in the iron-stone, combining with the lime of the limestone used as a flux. Grey slag contains, in 100 parts:—Silica, 38·25; alumina, 22·19; lime, 31·56; magnesia, 4·14; protoxide of iron, 1·09; manganese, a trace; sulphide of calcium, 2·95; but the composition of slag differs according to a variety of circumstances.

The author then discusses the means of converting slag into paving stones, applying it to the manufacture of sulphate of alumina, aluminate of soda, and pure silica for the manufacture of porcelain, for most of which purposes patents have been taken out. He then proceeds to point out a plan of his own invention in which the slag, after being brought into a suitable state of subdivision, is treated with hydrochloric acid, whereby silica is obtained in a gelatinous form, and the alumina, lime, magnesia, and iron dissolved; the solution is evaporated to dryness, washed with water to dissolve out the soluble salts, the insoluble residue is treated with sulphuric acid, by which means sulphate of alumina is formed, the solution of which may be decanted off; the silica after washing with water is left in a pure state. The sulphate of alumina may either be evaporated to obtain that salt in the solid and dry state, or it may be used for the manufacture of alum. By this process slag will give a product worth £3 per ton and another worth £7 per ton. The author uses hydrochloric instead of sulphuric acid, as it is, in many instances, a waste product. Every 100 tons of slag will yield 33 tons of silica and 147 tons of sulphate of alumina.

* Abstract of a paper read before the Cleveland Institution of Engineers, by Mr. Crossley.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

July 1st, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair.

THE minutes of the preceding meeting were read and confirmed.

The PRESIDENT stated that, as the meeting was an extraordinary one, the routine business would be dispensed with.

A written communication from Dr. Mills, on the subject of "*The Atomic Theory*," was read. No discussion followed, but the President said he should feel honoured if, after seeing in print what he himself had put together on the subject, they thought it worth while to go into the question some evening.

A paper by Mr. H. Smith, F.C.S., "*On Ethyl Hyposulphurous Acid*," was then read.

The author prepared ethylic sulphide by placing protosulphide of potassium in a retort with ordinary alcohol, passing the vapour of ethylic chloride into the liquid, and then applying heat, when a distillate, containing ethylic sulphide, alcohol, and ethylic chloride, came over. Water was added, and the oil which separated re-distilled. After rectification with calcium chloride, it had a constant boiling point at 81° C.

Ethylic sulphide was treated with an equal bulk of strong sulphuric acid, a large quantity of water added, and the whole neutralised with pure barium carbonate, the resulting solution of barium ethy-hyposulphite evaporated to one-third of its bulk, and set aside to crystallise. The author has also prepared the copper, silver, and sodium salts.

The PRESIDENT remarked that, according to the formula given by Mr. Smith, half of the metal of ordinary hyposulphites was replaced by ethyl, and it was merely analogous in its constitution to a sulphate. It did not, as far as he could see, bear in any direct way on the question of the constitution of the hyposulphites, which occupied their attention a few meetings since.

Mr. PERKIN wrote the following formula on the board:—Barium salt—$(C_2H_5)_2BaS_2O_6+2H_2O$. The sodium salt would, therefore, be:—$C_2H_5NaS_2O_3+H_2O$.

The PRESIDENT remarked that the constitutional water was still undisturbed.

A paper by Dr. Phipson, "*On the A*
Certain Organic Substanc
had found that cyanine

bling that of mauve. He also found that the colours of certain flowers gave absorption bands in the spectrum.

Mr. McLeod then explained "*An Apparatus for the Determination of Gases Dissolved in Natural Waters.*" The water is measured in a graduated pipette into which it is introduced without coming in contact with air, mercury being drawn from the bottom of the pipette, while a narrow tube connected with the upper part of the measure is passed to the bottom of the bottle containing the water. The water is then allowed to flow into the lower of two globes connected by a narrow glass tube, and in which a Torricellian vacuum has been produced. The lower globe stands in a water-bath heated to 50°, and the water is allowed to remain at that temperature for about 30 minutes. During this time almost the whole quantities of the nitrogen and oxygen dissolved in the water are evolved together with some carbonic anhydride. Mercury is then allowed to rise from a reservoir into the bulbs, and the gas, which has been evolved, removed by means of a Sprengel's mercurial pump, through a stop-cock at the top of the upper globe. After this, the mercury is run out from the globes and the water-bath more strongly heated, a slow current of cold water being allowed to trickle over the upper bulb. By this means the water is distilled *in vacuo*, and the gases remaining, which consist almost exclusively of carbonic anhydride, are eliminated from the water. These gases are then removed, as before, from the apparatus, by means of the Sprengel and analysed.

It was found necessary to resort to the process of distillation in order to decompose the soluble acid calcic carbonate; as some of this compound remained unaltered, even when maintained for two hours at a temperature of 105°—109° in a salt-water bath. The following results were obtained from 100 c.c. of a sample of tap water drawn from the cistern of the Royal College of Chemistry.

I.

	Gas evolved at 50°. c.c.	Gas evolved on distillation. c.c.	Total. c.c.
N.....	1·3906	0·0067	1·3973
O.....	0·6093	0·0113	0·6206
CO_2.....	0·4199	3·8769	4·2968
	2·4198	3·8949	6·3147

II.

	Gas evolved at 50°. c.c.	Gas evolved on distillation. c.c.	Total. c.c.
N.....	1·3956	0·0022	1·3978
O.....	0·6057	0·0135	0·6192
CO_2.....	0·4990	3·6809	4·1799
	2·5003	3·6966	6·1969

The mercurial pump employed in these experiments is slightly modified from that originally described by Dr. Sprengel, in the *Journal of the Chemical Society*, though in the three experiments which have been tried, the results have not nearly equalled those described in his paper. Dr. Sprengel obtained a residue of air in an exhausted receiver equal to 1-1,300,000th of the original quantity: the best result obtained in the above-mentioned experiments being only 1-516,666th. By means of this apparatus, however, Dr. Frankland and Mr. Lockyer have rarefied perfectly dry oxygen, nitrogen, and hydrogen to such an extent, that their resistance was equal to that of atmospheric air at the ordinary pressure. The quantity of carbonic anhydride in carbonates may be determined in the form of gas, as first suggested by Dr. Russell, the Sprengel being employed for removing the gas from the valve in which the carbonates are decomposed. For this purpose a weighed quantity of the carbonate is placed in a small glass tube, which is then introduced into a wide perpendicular tube about 900 m.m. in length, and provided with a stop-cock at the upper end. The lower orifice is placed under mercury, and the air removed by means of the Sprengel. Dilute sulphuric or hydrochloric acid is passed up the tube, and the carbonic anhydride which is evolved removed and measured. In two experiments, the quantities of carbonic anhydride evolved from white marble were 43·72 and 43·61 per cent.

"*A New Form of Apparatus for Gas Analysis.*"—This is a modification of the apparatus described some years ago by Dr. Frankland and Mr. Ward. It consists of two tubes, one about 5 and the other about 20 m.m. in diameter. These tubes are, respectively 1,100 and 900 m.m. long. They are surrounded by a cylinder, through which a constant stream of water flows, and communicate with one another, just below the wide cylinder, by means of a caoutchouc joint surrounded by calico. The lower end of the narrow tube is also connected, in a similar manner, with a tube provided with a stop-cock, and which descends 900 m.m. below the joint, and communicates, by means of a long flexible tube surrounded with calico, to a reservoir containing mercury, which is so suspended that it can be raised above the level of the top of the apparatus. The narrower tube is graduated in millimetres from the bottom to the top, the upper end being closed by a glass stop-cock. The wide tube is marked with divisions at every 100 m.m., the contents of each division being determined. This tube is provided with wires, and closed at the upper end by a capillary tube and glass stop-cock, with a steel cap, by means of which it may be attached to a short and wide laboratory tube, such as is used in the apparatus described by Dr. Frankland in the *Journal of the Chemical Society*, 2nd series, vol. VI., p. 109. The analysis of gases is performed with this apparatus in the same manner as with the original one of Frankland and Ward, the measurements being made by determining the temperature and tension of fixed volumes of gas. The absorptions are performed in the laboratory tube, and explosions in the measuring tube. The whole apparatus may be easily worked with 900 c.c. of mercury, and the results obtained are very satisfactory.

Dr. Russell read a paper entitled "*Further Experiments on the Atomic Weights of Cobalt and Nickel.*"

In 1863, the author published an account of researches on the determination of the atomic weights of cobalt and nickel by the reduction of the oxide by hydrogen, when he found the atomic weights of cobalt and nickel to be 29·37. Since then, experiments had been made by two other chemists, Sommannga and Winkler, the former of whom gave 29·99 for the atomic weight of cobalt, and 29·01 for nickel, while Winkler's determinations showed cobalt to be 29·49, and nickel, 29·53. More recently, Dr. Schneider, in a paper to *Poggendorff's Annalen*, called attention to the fact that Sommannga's determination of the atomic weights almost coincided with the numbers he had previously obtained, and endeavoured to explain why Dr. Russell's numbers differed from his own. The author had lately experimented with the same cobalt and nickel used before, and determined the atomic weights from the volume of hydrogen evolved when a known weight of the metal was dissolved in hydrochloric acid, and the results fully confirmed the accuracy of his former experiments. The mean of four experiments by the reduction of the oxides determined the atomic weights of both nickel and cobalt to be 29·37; the mean of four experiments from the volume of hydrogen evolved was 29·38 for each metal.

The President thought it a most admirable confirmation of the conclusion arrived at by different methods, that numbers so very nearly coincident with these should be obtained by this process, and it was satisfactory that the result was established by concurrent evidence of very different kinds.

Professor Wanklyn said that the experiments related by Dr. Russell were particularly interesting to him, as they confirmed the views expressed by himself and Mr. Chapman about the hydrogen process.

After a verbal communication "*On the Action of Phosphoric Chloride on Oil of Vitriol*," by the Rev. Mr. Williams, the meeting was adjourned till the next session.

QUEKETT MICROSCOPICAL CLUB.

The fourth annual general meeting was held on Friday evening last, in the library of University College. Mr. Arthur E. Durham, President, in the chair.

A report was read, which showed that 142 members had been elected since the last annual meeting, making a total of 512. The Treasurer's report showed that the finances were in a very satisfactory condition.

In vacating the chair which he had filled for two years the President delivered a highly impressive address, which was listened to with marked attention throughout.

The following gentlemen were elected to fill the offices named for the ensuing year:—

President—Mr. P. Le Neve Foster.

Vice-Presidents—Dr. R. Braithwaite, Mr. W. M. Bywater, Mr. E. A. Durham, Mr. H. F. Hailes.

Members of Committee—Mr. T. Crooke, Mr. B. T. Lowne, Mr. S. J. McIntire, Dr. J. Matthews.

Treasurer—Mr. R. Hardwicke.

Hon. Secretary—Mr. T. Charters White.

Hon. Secretary for Foreign Correspondence—Mr. M. C. Cooke.

A paper "*On the Ratio Micro Polariscope*," by Mr. James J. Field, its inventor, was read, at the conclusion of which the instrument was exhibited. Ten new members were elected, after which the proceedings terminated.

NOTICES OF BOOKS.

Laboratory Teaching; or Progressive Exercises in Practical Chemistry. By C. L. Bloxam. John Churchill and Sons. 1869.

We can scarcely imagine a man more competent to treat of laboratory teaching than Mr. Bloxam. Commencing his studies at the College of Chemistry, he soon became the first assistant there, and the work which he then brought out in conjunction with Mr. Abel has long been familiar to the student of practical chemistry; altogether, for no less than twenty-three years, has Mr. Bloxam been a teacher of laboratory practice; hence we have before us no imaginative system, elaborated in the mind but unpractised in the laboratory, but a system of instruction based on—nay, entirely made up of—experience. And it is not alone the most efficacious mode of teaching practical chemistry which must result from lengthy experience, but an exact and elegant manipulative skill; and an ingenuity in devising processes and experiments are alone attainable by this means.

The work before us is quite devoid of any theory; there is not a formula or a symbol in the whole book; it is essentially a treatise on *practical* chemistry. It contains in the words of the author—

(1.) "A series of simple tables for the analysis of unknown substances of all kinds (not excepting organic bodies) which are known to be single substances, and not mixtures.

(2.) "A brief description of all the practically important single substances likely to be met with in ordinary analysis, by which the learner may satisfy himself that his results are correct, and may, at the same time, become acquainted with the leading properties of the most important chemicals, and with the foreign substances which they are liable to contain.

(3.) "Simple directions and illustrations relating to chemical manipulation, not collected into a separate chapter, but given just where the learner requires them in the course of analysis.

(4.) "A system of tables for the detection of unknown substances with the aid of the blowpipe.

(5.) "Short instructions upon the purchase and preparation of the tests, intended for those who have not access to a laboratory."

Mr. Bloxam describes the various processes of chemical manipulation with an extreme minuteness of detail, and always effects his object by the simplest means; thus he says, "When a mortar is not at hand, substances of moderate hardness may be powdered on a hard surface by rolling a bottle over them;" a piece of broken porcelain may be often substituted for platinum foil; and Bunsen's burners may be improvised by placing a funnel over and a little distance above an ordinary gas-burner. We think, however, that a crudity of operation, although safe in the hands of a careful and accomplished chemist like Mr. Bloxam, may lead to carelessness and a want of delicacy and cleanliness in the student; it may lead him to regard processes which require the utmost skill as more or less rough operations, in which a large margin may be left for error of action. To our mind, we cannot have too elaborate or perfect apparatus for our infinitely delicate chemical operations; we cannot warn the student too often against inattention to minute points of cleanliness in his operations; we cannot too often impress upon him the necessity of rendering assurance doubly sure—the double rinsing of his cleaned (and nominally clean) test-tubes, and other vessels, the examination of the purity of his tests, the infinite solicitude which he must give to his boiling liquid, or his filtering solution, lest one small drop—be it but so much as makes "the twentieth part of one poor scruple"—be lost; and, although in qualitative analysis the need for extreme caution is to some extent removed, we must remember that a careless habit once acquired is not relinquished when the student passes to quantitative analysis. We were in a laboratory the other day which, for neatness and cleanliness, not to say primness, might vie with a Quaker's drawing-room; not a speck of dust was visible, not a bottle had dirty streaks of its contents coursing down its sides to deposit themselves on the shelf beneath; there was no confusion, and the air was as fresh as it ever can be in London; the usual dirty benches were replaced by clean slabs of plate-glass, whitened beneath, and everything was trim and smart. Yet this was not one of the laboratories of the *dilettanti*; there was plenty of good hard work going on in it; and, with a little management, all laboratories might be equally clean.

Mr. Bloxam has introduced a number of extremely useful tables into his work, to indicate the mode of detecting various elements and compounds; these tables are explained in the text, and constant back-reference is given to them and to individual paragraphs, which latter are distinguished by thick-letter numbers. Not only do we find the modes of detecting the simpler substances, but a large number of organic bodies are also introduced, together with the means of their identification; thus we find picric acid, cholesterine, acetone, naphthaline, aniline, and many other organic bodies described. Altogether, the work is most comprehensive; a great deal could be done with it; a chemist cast upon a desert island with it, and a box of reagents, could examine with ease all the principal products of the place, both mineral and vegetable. To the mining chemist, the work will be of much service; indeed, its usefulness is by no means confined to the student; we venture to assert that the book will be found useful in every laboratory as a work of quick reference and concise direction.

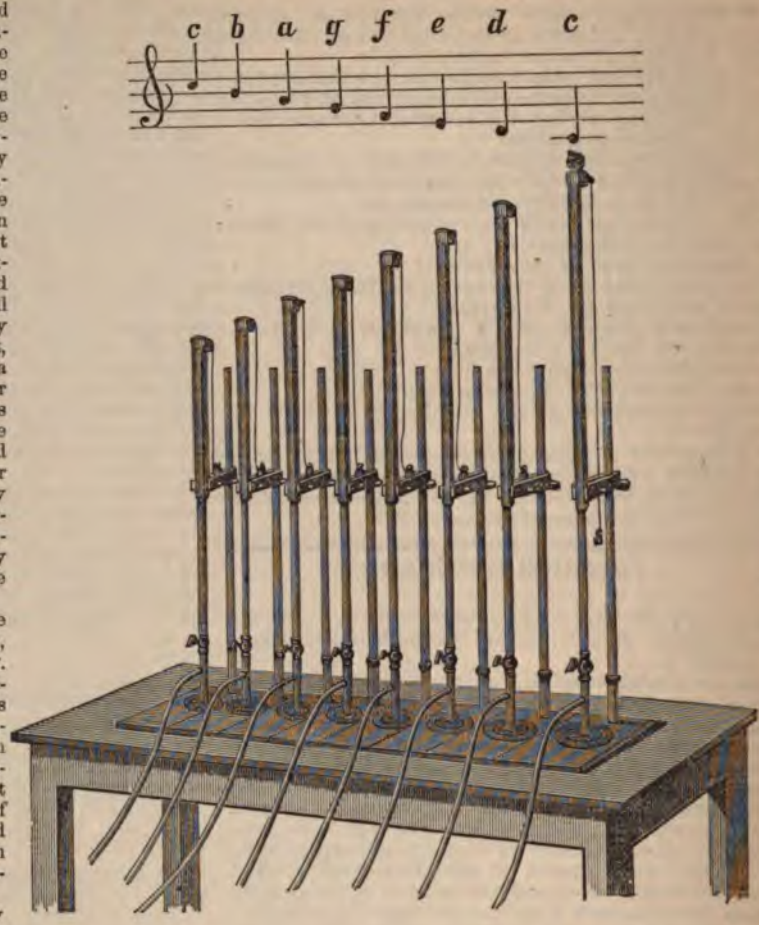
Mr. Bloxam is a thorough conservative; we imagine he is the General Peel of his party—a thoroughly conscientious, sound, true old tory, just a thought obstinate, but with the firmest convictions. It will be remembered that, in his "Chemistry Inorganic and Organic," he has not adopted the new nomenclature or the new equivalents; and we observe here that he has introduced such words as "white vitriol," "zinc-white," "Glauber's salt," and "Scheele's green." An air of conservatism pervades the whole work
not intend to deprecate this, but are rather
it may help to check the rapidity of modern
cal radicalism.

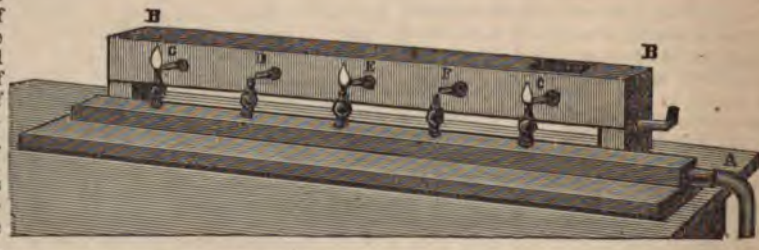
Cyclopædic Science Simplified. By J. H. Pepper. London: Frederick Warne and Co. New York: Scribner, Welford, and Co. 1869.

Of a verity this book is a small cyclopædia of science; the variety of subject-matter is astonishing, and six hundred wood-cuts lend their aid to the simplification. Within the memory of most of us the only source of very popular science for boys was to be found in the "Boy's Own Book," where science was bounded on the right by perhaps Cricket, and on the left by Boating, and the dominant experiment was the "Lead tree," while examples of chemical combination were ordered to be made somewhat after this fashion:—"Take a sixpence, put it in a small tea-cup, and pour upon it about a wine-glass full of aqua fortis; it will immediately dissolve; now add a pinch of salt, and the silver will fall down as a white powder," and so on. Now, for having led boys from such science as this, and given them sound science resulting from the labours of sound men, and often accompanied by their own explanations, we think every school-boy ought to thank Mr. Pepper. He cannot open this book without having his mind simultaneously opened, and it is his own fault if he ever closes it again.

As for subject matter, we have light, heat, electricity, magnetism, pneumatics, acoustics, and chemistry. In the article on Light, a detailed account, accompanied by woodcuts, is given of the celebrated ghost delusion, which surprised us all so much a few years ago, and of which M. Marion has given such a capital account in his *Merveilles de l'Optique*, one of that admirable series well called 'Bibliothèque des Merveilles," from whatever point of view we may consider it.

If we specialize at all we may perhaps mention the chapter on Acoustics as being well illustrated. The accompanying figure represents the "gas flame organ," by means of which, we are told, simple tunes have been played; while in the second figure, we have the apparatus of Pichler for showing the position of the nodal points and ventral segments in a vibrating column of air. When the column of air in the tube, B B, is caused to vibrate, the gas jets, D and F, which are opposite to the centres of ventral segments, are blown out, while the jets, C, E, G, remain lighted, because they are opposite to nodal points—that is, points where the column of air is at rest.





Mr. Pepper also tells us lots of scientific "dodges," explains the talking head of Albertus Magnus, and indicates the true position of the "invisible girl," who, being in communication with "a sort of ornamental bedstead," yet all unseen, answers any questions addressed in the neighbourhood thereof. But there is much severer science than this; we would refer to the accounts of magnetism and dia-magnetism specially, also to the account of the Atlantic cable; in fact, we recommend all young fellows with any glimmer of a taste for science, to take the book home with them at the approaching summer holidays, to read it carefully, and, as far as is possible, experimentalize for themselves.

Sound: A Course of Eight Lectures delivered at the Royal Institution of Great Britain. By John Tyndall, F.R.S. Second Edition. London: Longmans, Green, and Co., 1869.

Dr. Tyndall has proposed to himself to publish a series of works on Natural Philosophy, suited not only to the requirements of the students, but, as far as is practicable, to the popular ear. They are to have as their bases, the lectures which he is in the habit of giving, year by year, at the Royal Institution, and already two such handbooks have

appeared—the well-known treatise "On Heat Considered as a Mode of Motion," and the treatise "On Sound," the second edition of which we have before us. The value of these works is too well known to the scientific to need any mention here. They form the most complete separate works on the several subjects of which they treat to be found in this language, and Dr. Tyndall is careful to introduce the most recent researches of continental philosophers, many of which are not readily accessible to the English public.

In comparing our scientific works with those of France and Germany, there are, however, several most notable differences; differences which rest with the publisher rather than the author, and until these be overcome we cannot have any great diffusion of standard scientific works in this country. We allude chiefly to the great expense of our works on science, and the above are no exception to the rule. Let any of our readers look at the volumes of the admirable *Bibliothèque des Merveilles* at 2 francs the volume, and ask himself what would be their price in this country—certainly seven shillings and sixpence. They are by eminent men, are well printed, and well illustrated, and such a series would be a great boon to this country. As to woodcuts, they, for the most part, excel those of our best works on science, into which we rarely introduce copper or steel plates, and coloured engravings less rarely still.

The second edition of Tyndall "On Sound" differs but slightly from the first; the main difference is the addition of an appendix of 9 pages, containing an account of the recent researches of M. Regnault on the propagation of sound, written by himself. Many of our readers have heard Dr. Tyndall's lectures on sound, and will remember how well they were illustrated, specially as regards the production of Lissajous' figures, drawings of many of which are given.

The first lecture treats of the production and propagation of sonorous waves through various media. The second distinguishes between noise and music, musical pitch is defined, and a good account of the admirable "double syren" of Helmholtz (from his "*Die Lehre von den Tonempfindungen*,") is given. In the third lecture is discussed the vibration of strings, the general nature of progressive and stationary waves, and the optical examination of the vibrations of a piano wire. Lecture 4.—The vibrations of rods, square plates, discs, and bells. Lecture 5.—The vibrations of columns of air in organ pipes, the human voice, and reed-pipes. Lecture 6.—Sounding flames which have of late engaged so much attention. Lecture 7.—The interference and coincidence of sonorous waves, and the theory of "beats." Lecture 8.—The conditions of musical consonance, the harmony of musical sounds, and the optical examination of musical intervals.

The work is well illustrated for an English scientific book, and the style is agreeable, yet the book is more for the student than for the general reader; nine out of ten well-educated persons unacquainted with science could not comprehend many of the subjects discussed without reference to other works bearing on the subject. As a handbook for the student of science it is a valuable contribution to our scientific literature.

Traité Elémentaire de Physique. Par A. Privat Deschanel, Ancien Professeur de Physique au Lycée Louis-le-Grand. Paris: Hachette et Cie. 1869.

During the last few years, there has issued from the French press (and notably from the press of Messrs. Hachette) a series of beautifully-illustrated works, having for their object the popularisation of science. We need not do more than refer to "Le Ciel," and "Les Phénomènes de la Physique" of M. Guillemin, with their beautifully-coloured plates, their copper-plates, and their innumerable woodcuts. The recently-translated "Vie Souterraine" of M. Simonin is another example. In fact, the world has shown its appreciation of these works by the rapidity with which translations have been made into numerous languages. We saw the other day an "edition de luxe" of Guillemin's "Le Ciel" in Greek; and we should suppose that, by this time, it is to be found in Hindoostanee, perhaps in Chinese. There is no denying that we have no books among our native scientific literature which can compare with these: somehow our drawings of apparatus are heavy and cold, there is nothing artistic about them, and they are too often repellent to the eye, rather than attractive.

The book before us, although not belonging to the class of "Le Ciel," boasts three coloured plates, and 719 woodcuts in its thousand and eight pages. It is rather a student's manual than a popular work on physics. The subject matter is arranged in the following order:—Mechanics; Hydrostatics; Pneumatics; Hydraulics; Heat; Electricity; Acoustics; Optics. "Le traité," says M. Deschanel, "que je publie aujourd'hui est destiné à faciliter le travail des jeunes gens qui veulent obtenir ces grades" (universitaires), and, coming as it does from a man who, for nearly twenty years, was Professor of Physics in the Lycée Louis-le-Grand, it is a valuable contribution to French educational works.

Although by no means overloaded with mathematics, we are glad to observe the introduction of mathematical formulæ, wherever it is possible, without adding a great complexity to the matter discussed.

In the "Pneumatics," we notice an account of M. Kravogl's mercury air-pump, also of that of Geissler, but we seek in vain for mention of the admirable Sprengel pump.

The chapters on Heat are good, and are clearly written, but we think an insufficient mention has been made of Tyndall's experiments on the absorption and radiation of heat by gases, while the space devoted to the mechanical theory of heat is undeniably too short.

A good account, accompanied by a capital drawing, of the "machine à gaz" of MM. Otto and Lungen will be found on p. 306, and of the electrical machine of M. Holtz on p. 357. The subject of static electricity has been discussed with perhaps more diffuseness than any other subject. In dynamic electricity, we notice a very clear exposition of the actions of solenoids.

A chapter is devoted to the "Effets calorifiques produits par les courants," in which will be found a charmingly artistic drawing of the magnified "image des charbons" of the electric lamp; and, while we are on the subject of the woodcuts, let us mention No. 576 ("Propagation du son dans un milieu indefini") as singularly felicitous and elegant.

Of the book as a whole, we may say that we cordially recommend it to the student of science; he will find it clear and concise, abounding in good woodcuts, and remarkably moderate in price.

Qualitative Chemical Analysis. By Dr. C. Remigius Fresenius, Director of the Chemical Laboratory at Wiesbaden. Seventh edition. Edited by Arthur Vacher. London: John Churchill and Sons, 1869.

Many years ago, when analytical chemistry was but little studied in this country, and the few who practised it used Rose's "Handbuch der Analytischen Chemie," Mr. Lloyd Bullock introduced a translation of the works of Dr. Fresenius on "Qualitative and Quantitative Analysis." These are so well known to chemists, and have become such thoroughly standard authorities, that it is almost unnecessary to notice a new edition.

The "Qualitative Analysis," unlike the Quantitative, has diminished rather than increased in bulk, and this arises from an increased condensation and an alteration in some respects of the arrangement of the work. "This edition," says Mr. Vacher in the preface, "differs greatly from the last . . . The language has been condensed, the notation and nomenclature have been modernised, the arrangement has been simplified."

We are glad to notice the removal of
cross references, which formerly a
ready sufficient difficulties of the b

reminded us of one of the more complex pages of "Bradshaw."

The work, as now arranged, is divided into the following sections:—1. Reagents, apparatus, and manipulation; 2. Reactions and separations; 3. General analysis; 4. Special analysis; 5. Reactions and separation of rare inorganic bodies; 6. Reactions and separation of organic bodies; 7. Detection of poisons in bodies, food, &c.; 8. Tables. The few tables which are given are eminently serviceable, and might, with advantage, be printed separately on calico for laboratory use. It is a grand mistake to print tables on paper which are to be used side by side with the test-tube rack, and to bind them up with a book; we all know how soon they become torn, and discoloured, and acid stained. Such tables, together with works on chemical manipulation, might with advantage be printed upon calico or vegetable parchment.

Every book which is meant for constant laboratory use should have a special binding, as durable as binding can be made, and, best of all, literal boards of thin oak. We have the misfortune to possess a copy of Regnault's "Cours de Chimie," bound elaborately in white vellum. An *edition de luxe* of a work on chemistry is a far more useless object than an *edition de luxe* of a treatise on the infinitesimal calculus, and may be classed with silver trowels, ivory croquet mallets, Louis Quatorze clocks, and other ornamental but useless—at least, unpractical—things. A certain great king, we are told, once presented a certain great chemist with a laboratory, in which every vessel was of platinum; this was a laboratory *de luxe;* give us good glass, say we, with a judicious sprinkling of the above precious metal, with homely porcelain and still homelier Stourbridge clay, and we leave kings' gifts to kings' chemists, albeit a little Royal patronage would not be unserviceable to our science.

To return to our book; we may observe that the "Qualitative Analysis" of Fresenius is not so much in vogue as his "Quantitative Analysis," and this arises from the fact that there have arisen in our native chemical literature—sparse though it be—various works on "Chemical Manipulation," and "Laboratory Practice;" again, many teachers adopt a special form of their own, based, perhaps, upon that of Fresenius, but differing in character and arrangement therefrom. Still it looks well to have a seventh edition of any work on chemistry in this country, and we wish Messrs. Bullock and Vacher further success. We would suggest in conclusion that the utterly inadequate index of *less than two pages* should at least be trebled in size in the next edition.

Dictionnaire de Chimie Pure et Appliquée. Par AD. WURTZ. Paris: L. Hachette.

THE first *fascicule* of this work gives us some idea of its ultimate extent: although printed in somewhat small type, and in double columns, the 160 pages carry us only as far as Allyle. We shall review the whole work at length when it appears in its entirety, meanwhile, we propose rather to call attention to its general character than to give a review. M. Wurtz is assisted in his labours by no less than seventeen *collaborateurs*, among whom we notice the names of Debray, Emile Kopp, Lauth, and Naquet. The subject matter includes—Inorganic and Organic Chemistry; Chemistry applied to the Arts, Manufactures, and to Agriculture; Analytical Chemistry, and "La Chimie Physique et la Minéralogie."

We notice in this number an admirable article by M. Salet on "Affinity," terminated by a list of works relating to the subject which commences with the *Pyrosophia* of Barchusen (1698). We almost think that such a list is incomplete without the *Physica Subterranea* of Beecher, the *Tractatus Quinque Medico Physici* of Mayow, and the *Fundamenta Chemiæ* of Stahl, but it must be allowed that the idea of affinity possessed by these men was excessively crude and indefinite. Perhaps Otto Tachenius may also be quoted as having a glimmer of the action of predisposing affinity. The article on "Air" by M. Le Blanc is unfortunately short, and does not make mention of the more recent researches on impure and vitiated air. M. Caventon supplies an article on "Alkaloids," and he herein furnishes a very complete list of these bodies, including some which can scarcely be called familiar; for instance, Chiococcine (*Chiococca racemosa*); Ménispermine (*Menispermum cocculus*); and Surinamine (*Geoffræa Surinamensis*). In a somewhat elaborate article on "Alcohols" by Kopp, a very good description (accompanied by woodcuts) is given of the various stills which are used in the process of manufacture, among them the ingenious *appareil Champonnois*. We shall return to this work on its completion; meanwhile, we have no doubt that it will be found in every chemical library.

LABORATORY NOTES.

ACTION OF SODIUM ON WATER AND NITRIC ACID.

I SEND a few facts which you may perhaps consider worth a place in some corner of the CHEMICAL NEWS.

When sodium is thrown upon water, the hydrogen does not kindle, as we all well know, unless the water be warmed, or the metal confined to one spot by blotting-paper. If sodium, however, be dropped upon nitric acid of specific gravity 1·36 (ordinary commercial), the hydrogen burns with ease; but if the acid be diluted this result ceases. I thought it of interest to ascertain the point of dilution, which was conducted in the following way:—The concentrated acid, to the extent of 680 grains, was placed in a beaker, which again was placed in a vessel of water; a fragment of sodium of equal size was then added, the acid being diluted with 25 grains of water before each addition of sodium. The rise of temperature consequent upon this dilution (always two degrees) was allowed to fall back to that of 66° F., at which the experiments were commenced. Seventy-two experiments gave as the result, that the hydrogen ceased to kindle when the acid was diluted to specific gravity 1·056. The residue contained a fair amount of ammonia. I have used this dilute nitric acid with advantage, when showing the preparation of hydrogen by potassium and sodium as a lecture experiment, as the results then appear similar. No doubt the rapid oxidation of the sodium into nitrate is the explanation. I am, &c.,

THOMAS BLOXAM,
Lecturer on Chemical and Natural Philosophy, Cheltenham College.

CORRESPONDENCE.

The Faraday Memorial.

To the Editor of the CHEMICAL NEWS.

SIR,—I read with regret that the proposed memorial to Faraday is to be in the form of a statue in St. Paul's Cathedral. I am very sorry to differ from those who, doubtless knowing Faraday better than I did, though they could not have loved him more, support this proposal. Government has refused to contribute anything to the memory of this great man, on the ground that he did not hold the position of a public servant. Had he been a fighting man, doubtless a statue would have been raised to his honour. But why should we attempt to rival Government in erecting a statue in a State church? Ought we not rather to make our memorial take a scientific and beneficent form, such as Faraday himself would have approved? England can do many things well, but she cannot make an artistic statue. Why, then, should we waste this splendid opportunity of doing good in the production of a wooden figure at great cost? And the good I would propose is the creation of a permanent fund for the encouragement of poor students in science, and poor investigators. Many would give—I for one—their five guineas to such a fund, who would withhold it if the money is to be spent on stone. There are poor boys in poor

schools who display an unusual amount of talent, but for want of means of patronage have no opportunity of rising. Could not such boys be collected in a Faraday college, and trained up in science? We might thus get the pick of undeveloped talent throughout these islands.

Faraday, who shunned empty titles, does not want a statue. His kindly feeling was always extended to workers in science. I have several times received a word of encouragement from him, either written or spoken, when it was most refreshing because most needed. I will mention an example of his self-denying kindness, which is not, I believe, known, although thousands of such cases might be collected, for no one came in contact with Faraday without receiving some benefit.

Mr. Weale, the publisher, told me that a scientific man, having agreed to write a book for him, delivered the copy and then had to go abroad. Mr. Weale read the proof-sheets. In one sheet several difficulties occurred which he could not solve. Not knowing who to apply to, he bethought himself of Faraday, although personally unknown to him. The messenger arrived at the Royal Institution, delivered the parcel, and said he would wait. "It is of no use," said the porter, "Mr. Faraday is unwell, and is ordered out of town; he is just going to start." While the messenger was remonstrating, Faraday appeared, carpet-bag in hand, took the packet, and read the letter. "Oh, yes," said he, "I will do this for Mr. Weale. I can go by the next train."

Can the memory of such a man be honoured by resorting to the worn-out custom of erecting an ugly statue?—I am, &c.,

F. R. S.

June 25th, 1869.

Superphosphates.

To the Editor of the Chemical News.

Sir,—I observe in the Chemical News of last week an inquiry regarding the possibility of distinguishing between mineral and bone phosphates in superphosphates. If your correspondent will take two samples, one of a bone-ash and the other a coprolite superphosphate, and precipitate the insoluble phosphate by ammonia, and burn the precipitates, he will see that there is such a marked difference in the appearance of the two as to render it very easy to distinguish the one from the other.

Should your correspondent desire it, I shall be most happy to give him any information I can on the subject.—I am, &c.,

Arthur E. Davies, Ph.D.

Analytical Laboratory,
St. Mary's Gate, Manchester,
June 30th, 1869.

Explosion of Nitroglycerine.

To the Editor of the Chemical News.

Sir,—The frightful explosion of three-quarters of a ton of nitroglycerine in Wales, last week, and the deplorable loss of life and injuries attending it, may probably lead to some consideration on the part of the authorities as to whether an explosive agent apparently so unsafe should be allowed to be imported, or even used, in this country, notwithstanding that it appears to be established, at least to the judgment of many competent authorities, that for blasting a certain class of rocks there is no other agent at once so cheap in proportion to power and so effectual as nitroglycerine. The explosion referred to does not appear to have been the result of any carelessness; the "oil" was packed in metal canisters, which were surrounded by sawdust, and no one who has experimented with nitroglycerine can well attribute the explosion to any concussion that could have been caused by the jolting of the waggon in which it was conveyed, over, even, a somewhat rough road. Must, then, this explosion be classed with that which took place in Australia when the oil was at rest in a cellar? It would seem so. But if so, no confidence can be felt in employing an agent which may go off at any time; and the risk to life and property incurred in using it, will overbalance any possible advantage to be derived from its economy and efficiency.

Yet it is stated that nitroglycerine is *safer* than gunpowder. It is certainly less liable to be exploded by fire, and to disrupt the slender link which retains its elements, subject to chemical force, and set its mechanical force at liberty, by concussion, needs that concussion be sudden and forcible. I believe that a bottle full of blasting oil may be dashed to the ground without much danger, yet a drop of it upon a stone may be exploded by a blow from a hammer. Now what can be the possible cause of such unexpected explosions as have taken place? I can see only two possible reasons—First, that the oil undergoes decomposition or chemical change under certain at present unknown conditions, of time, temperature, shaking, &c., which predispose it to undergo a complete and sudden decomposition from causes ordinarily inadequate; secondly, that the cases and bottles in which it is contained, being air-tight, are liable, from a very trifling escape of gas from the liquid, to arrive at a state of tension from which the passage to a sudden break is easy. But would the mere bursting open of a bottle or tin case produce concussion sufficient to determine an explosion of the oil, unless we suppose the latter to be altered in quality? I think it would. I have known a stout glass bottle, used in an ethyl experiment, to be shattered by slowly gathered internal pressure into *dust*, with a report like the firing of a pistol. In a close vessel, full, or very near full of the oil, not much gas relatively to the quantity of liquid need be evolved in order to induce such a degree of pressure as might cause explosive rupture of the vessel. If one vessel burst, the concussion would certainly explode also any that might be near.

If the true cause of these seemingly anomalous explosions is indicated above, the remedy is both simple and inexpensive. Let every vessel containing the oil have fitted to it a tube, with a capillary bore, such as a piece of thermometer tubing, one end of the tube entering the oil, the other exposed outside.

If the tube were enlarged below to make room for any expansion of the liquid by elevation of temperature, none could be forced out by that alone, and none could be spilt through the capillary orifice of the tube by inverting the vessel. With a little management in the arrangements, any overflow might be made certainly indicative of the formation of permanent gases, which would be a warning signal. This method might also be applied experimentally to determine the probability or otherwise of the suggestion I have made as to the cause that may have led to these fearful explosions.

Certainly, the time is come when science should, in the cause of the public safety, investigate the "why" and the means of prevention of such horrors as that of the late catastrophe.—I am, &c.,

E. S.

Ramsay, Isle of Man,
July 7, 1869.

The Chemical Section of the British Association: The Official Report.

To the Editor of the Chemical News.

Sir,—On comparing the official report of my paper entitled "Researches on the Ethers," with my paper as it appeared in the Chemical News some time ago, I was astonished to find striking differences between them.

In justice to you as well as to myself, I beg to state that the version which you have published is the authentic version, and that in the official one the alterations have been made without my knowledge. Possibly I may bring this matter before the Exeter meeting of the Association. I am, &c.,

London Institu[illegible]

Oleographs.

To the Editor of the Chemical News.

Sir,—During some months past there have been sent to me various paragraphs from general and trade newspapers, prices current, penny magazines, &c., praising Dr. Moffat's oleographs as being valuable in the oil trade, to druggists, &c., and associating them with my name. I have this day seen a notice which states that Dr. Moffat's oleographs are based on the cohesion figures of Mr. Tomlinson, "published last year."

In the Chemical News for the 11th December last (vol. xviii., p. 284—*American Repr., Feb.* 1869, *page* 94), I gave the history of my discovery, dating from 1861, and published in that year, and in your number for 29th January last (vol. xix., p. 59—*American Repr., Mar.* 1869, *page* 157), I recorded my opinion of these oleographs. I stated that they are without distinctive characters, and are consequently valueless as oil-tests.

Unless Dr. Moffat has wonderfully improved on the specimens he sent to me I do not understand how he can sanction, or, at any rate, allow to pass uncontradicted, the puffing paragraphs to which I refer. I have not the means nor the inclination to get counter statements inserted in the journals referred to, but I do hope that after this second protest in your columns Dr. Moffat will use his influence to correct the misapprehension which must arise from such paragraphs.

The cohesion figures of liquids are in themselves oil-tests; but when transferred to paper, as in these oleographs, the resemblance between the figure of one oil and that of another is so close that they may be taken as identical, and they are, therefore, for practical purposes, useless, as friends of mine connected with the oil trade have proved.

While heartily wishing success to oleography, I cannot see much prospect of it in the present state of the art, and I am sure that Dr. Moffat would not wish to describe as a finished picture that which is only a rough, and by no means correct sketch.—I am, &c.,

C. Tomlinson.

Highgate, N., July 26th, 1869.

Gaseous Spectra.

To the Editor of the Chemical News.

Sir,—Our attention has been drawn to a letter from Mr. W. Huggins, in your impression of the 9th instant (*American Repr., Sept.* 1869, *page* 164), stating that, in a recent note to the Royal Society (in which we announced that, by varying the conditions of pressure and temperature, we had reduced the spectrum of hydrogen, as seen in our instrument, to one line absolutely, and the spectrum of nitrogen to one line nearly), we did not notice similar observations of his own presented to the Royal Society in 1868. In reply, we beg to state—First, that we did notice Mr. Huggins's observations, and, secondly, that they were not similar to our own.

With regard to the first point. The account you were good enough to publish contained the following:—"The bearing of these latter observations on those made on the nebulæ by Mr. Huggins, Father Secchi, and Lord Rosse is at once obvious. The visibility of a single line of nitrogen has been taken by Mr. Huggins to indicate possibly—First, 'a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect;' and then, secondly, 'a power of extinction existing in cosmical space.'

"Our experiments on the gases themselves show not only that such assumptions are unnecessary, but that spectrum analysis here presents us with a means of largely increasing our knowledge of the physical constitution of these heavenly bodies."

We thus gave briefly the results of Mr. Huggins's enquiries, and references to where a complete account of his observations were to be found. This we considered to be sufficient, seeing that our communication was a preliminary *note* only. In the complete account of our researches to be subsequently presented to the Royal Society we shall, of course, dwell upon them at greater length.

With regard to the second point—the similarity of the observations. In 1864, Mr. Huggins first observed the spectrum of the nebulæ, and determined that one of the lines was coincident with one of the air lines due to nitrogen, the spark being taken close to the spectroscope. On this Mr. Huggins wrote:—"The speculation presents itself, whether the occurrence of this one line only in the nebulæ may not indicate a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect." Some time afterwards, Mr. Huggins, instead of taking the air spark close to the spectroscope, placed it outside the object glass of his telescope, and then only saw one line in the spectrum—the line in question. He next got similar results close to the spark by interposing a dark glass to cut off the light, still using the spark in air at the ordinary pressure, and remarked that it was "obvious" that the hydrogen spectrum would give similar results. Then, after stating "we cannot suppose that any lines have been extinguished by the effect of the *distance* of these objects from us," he refers to the possibility of a "power of extinction residing in cosmical space," and the hypothesis of the more simple form of nitrogen appears to be given up.

Now, with regard to our own observations, we have *not* taken the spark in air; we have *not* used a dark glass; we have *not* worked at atmospheric pressure; nor have we disturbed the normal distance of the experimental tube from the slit of our instrument until we had reduced the complicated spectrum of nitrogen to one bright line and three or four other extremely faint ones. Further, we have *not* rested content with any assumption with regard to hydrogen, nor have we regarded anything as obvious.

What we have done is to carefully watch both spectra changing as the pressure becomes less, trying the effect of increased and decreased temperature at every stage, under various conditions, which we shall state in our detailed paper.

It may be as well to refer, in conclusion, to Plücker's important work on nitrogen, which shows that, under certain conditions, the green line of nitrogen vanishes altogether from the spectrum. This fact alone shows at once the importance of our method of inquiry.—We are, &c.,

E. Frankland.
J. Norman Lockyer.

Royal College of Chemistry, Oxford Street,
July 23, 1869.

Gaseous Spectra.

To the Editor of the Chemical News.

Sir,—In the paper on "Researches on Gaseous Spectra in Relation to the Physical Constitution of the Sun, Stars, and Nebulæ," by Dr. Frankland and Mr. Lockyer, as reported by you, the authors do not notice similar observations which I presented to the Royal Society in April, 1868. I send you the following extracts from that paper, which is printed in the *Phil. Trans.* for 1868.—I am, &c.,

William Huggins.

"The following observations are suggestive in connection with the point under consideration. Electrodes of platinum were placed before the object-glass in the direction of a diameter, so that the spark was as nearly as possible before the centre of the lens. The spark was taken in air. I expected to find the spectrum faint, for the reasons which have been stated in a previous paragraph (the diminution of the brightness of the spark from the distance at which it is placed from the slit), but I was surprised to find that only one line was visible in the large spectroscope when adapted to the eye-end of the telescope. This line was the one which agrees in position with the line in the nebula, so that under these circumstances the spectrum of nitrogen appeared precisely similar to the spectra of those nebulæ, of which the

light is apparently monochromatic. This resemblance was made more complete by the faintness of the line; from which cause it appeared much narrower, and the separate existence of its two components could no longer be detected. When this line was observed simultaneously with that in the nebula, it was found to appear but a very little broader than that line. When the battery circuit was completed, the line from the spark coincided so accurately in position with the nebular line, that the effect to the eye was as if a sudden increase of brightness in the line of the nebula had taken place. In order to make this observation, and to compare the relative appearance of the lines, the telescope was moved so that the light from the nebula occupied the lower half only of the slit. The line of the spark was now seen to be a very little broader than the line of the nebula, and appeared as a continuation of it in an unbroken, straight line. These observations were repeated many times on several nights."—(P. 542.)

"The double line in the nitrogen-spectrum does not consist of sharply-defined lines, but each component is nebulous, and remains of a greater width than the image of the slit.* The breadth of these lines appears to be connected with the conditions of tension and of temperature of the gas. Plücker † states that when an induction-spark of great heating power is employed, the lines expand so as to unite and form an undivided band. Even when the duplicity exists, the eye ceases to have the power to distinguish the component lines, if the intensity of the light be greatly diminished.

"Though I have been unable to detect duplicity in the corresponding line in the nebula, it might possibly be found to be double if seen under more favourable conditions; I incline to the belief that it is not double. ‡

"In my tables of the lines of the air § I estimated the brightness of each of the components of the double line in the spectrum of nitrogen at 10, and the components of the double line next in brightness in the orange at 7 and 5, and those of a third double line on the less refrangible side of D at 6 and 4. It was with reference to these two double lines next in apparent brilliancy that I wrote, ‖ in speaking of the line in the nebula, 'If, however, this line were due to nitrogen, we ought to see other lines as well; for there are specially two strong double lines in the spectrum of nitrogen, one at least of which, if they existed in the light of the nebulæ, would be easily visible.'

"As the disappearance of the whole spectrum of nitrogen, with the exception of the one double line, was unexpected, though, indeed, in accordance with my previous estimations, I examined the spectrum of nitrogen with a spectroscope furnished with one prism, with a refracting angle of 60°, in which the whole of the spectrum from C to G is included in the field of view. I then moved between the eye and the little telescope of the spectroscope a wedge of neutral-tint glass, corrected for refraction by an inverted similar wedge of crown glass, and which I had found to be sensibly equal in absorbing power on the different parts of the visible spectrum. As the darker part of the wedge was brought before the eye, the two groups in the orange were quite extinguished, while the lines in the green still remained of considerable brightness. The line which under these circumstances remained longest visible next to the brightest line, was one more refrangible at 2669 of the scale of my map. This observation was made with a narrow slit. When the induction spark was looked at from a distance of some feet with a direct-vision prism held close to the eye, I was surprised to observe that the double line in the orange appeared to me to be the brightest in the spectrum, and when the neutral-tint wedge was interposed, this line in the orange remained alone visible, all the other lines being extinguished.

"When, however, in place of the simple prism a small direct-vision spectroscope provided with a slit was employed, I found it to be possible, by receding from the spark, to find a position in which the double line in the green, with which the line in the nebula coincides, was alone visible, and the spectrum of the spark in nitrogen resembled that of a monochromatic nebula.

"It is obvious that if the spectrum of hydrogen were reduced in intensity, the line in the blue, which corresponds to that in the nebula, would remain visible after the line in the red and the lines more refrangible than F had become too feeble to affect the eye.

"It therefore becomes a question of much interest whether the one, two, three, or four lines seen in the spectra of these nebulæ represent the whole of the light emitted by these bodies, or whether these lines are the strongest lines only of their spectra which, by reason of their greater intensity, have succeeded in reaching the earth. Since these nebulæ are bodies which have a sensible diameter, and in all probability present a continuous luminous surface, or nearly so, we cannot suppose that any lines have been extinguished by the effect of the distance of these objects from us.

"If we had evidence that the other lines which present themselves in the spectra of nitrogen and hydrogen were quenched on their way to us we should have to consider their disappearance as an indication of a power of extinction residing in cosmical space, similar to that which was suggested from theoretical considerations by Chéseaux, and was afterwards supported on other grounds by Olbers and the elder Struve. Further, as the lines which we see in the nebulæ are precisely those which experiment shows would longest resist extinction, at least so far as respects their power of producing an impression on our visual organs, we might conclude that this absorptive property of space is not *elective* in its action on light, but is of the character of a *general* absorption acting equally, or nearly so, on light of every degree of refrangibility. Whatever may be the true state of the case, the result of this re-examination of the spectrum of this nebula appears to give increased probability to the suggestion that followed from my former observations, namely, that the substances hydrogen and nitrogen are the principal constituents of the nebulæ of the class under consideration."—(Pp. 543—544.)

* Secchi states that with his direct spectroscope this line in the annular nebula in Lyra appears double. As the image of the nebula is viewed directly, after elongation by the cylindrical lens, and without a slit, it is probable that the two lines may correspond to the two sides of the elongated annulus of the nebula.

† *Philosophical Transactions*, 1863, p. 13.

‡ "On the Spectra of the Chemical Elements," *Philosophical Transactions*, 1864, p. 141.

§ Ibid.

‖ Ibid., p. 443.

MISCELLANEOUS.

Jargonium.—We learn from the *American Journal of Mining*, of June 12th, 1869, that, at a meeting of the Polytechnic Association of the American Institute, held on June 3rd, a note was read "*On Jargonium*," which referred to the exhibition of jargonia by Mr. Sorby at the *soirée* of the Royal Society, and also to the communication by Professor Church in the CHEMICAL NEWS for March 12th (*Amer. Repr., May*, 1869, *page* 231). After the reading of the note, Dr. Isidor Walz spoke as follows:—"It will be remembered that, at a meeting of the New York Lyceum of Natural History, Professor Loew announced the discovery of Jargonium before the number of the CHEMICAL NEWS which contained an account of Mr. Sorby's discovery had reached this country. The discovery was, undoubtedly, made by the English and American discoverers quite independently of each other."

Endowment of a School of Practical Chemistry.—Mr. James Young, the late proprietor of the extensive works at Bathgate, near Glasgow, and manufacturer of paraffin and paraffin oils, whose name, in fact, is intimately associated with this manufacture as the discoverer of the process by which these valuable products have for many years been produced from certain varieties of coal, is stated to have presented the sum of £10,000 to the Andersonian

Institution, Glasgow, for the endowment of a school of practical chemistry.—*Pharm. Journ.*

Royal School of Mines.—At a meeting of the Council on Saturday, the 3rd inst., the results of the examinations for the past session were declared. The following gentlemen, having passed the requisite examinations, have obtained the title of "Associate of the Royal School of Mines" in the divisions mentioned:—Bell, Metallurgical; G. Broome, Mining and Metallurgical; L. Brown, Metallurgical;—Butler, Geological; R. J. Frecheville, Metallurgical; G. Green, Metallurgical and Geological; M. F. Maury, Mining and Metallurgical; F. J. M. Page, Mining and Metallurgical;—Tayler, Metallurgical. The following prizes and scholarships were awarded:—Two Royal Exhibitions of £15 for first year students—(1) J. J. Bowrey; (2) W. Gowland. H.R.H. The Duke of Cornwall's Scholarship, £30 for two years—W. J. Sollas. Royal Exhibition of £25 for second year students—W. Gowland. D. La Beche Medal and Books, for Mining—G. Broome. The Director's (Sir Rod. I. Murchison's) prize for Geology—W. Gowland.

Inexhaustible Manures.—In the Atlantic Ocean, a little to the west of the Azores, there exists a space seven times larger than all Germany, according to the late A. von Humboldt, completely covered with a dense mass of vegetation, the so-called Sargasso Sea. M. J. Lavinière has proposed to the Société d'Agriculture to make these floating meadows, as they are called by Aviedo, subservient to the purposes of agriculture. His suggestion is that the ships occupied during the summer in cod-fishing should, in other seasons, be employed in conveying this abundant and excellent manure to the Azores, where an *entrepôt* could be established, the weeds pressed and dried, and the salts they contain extracted. Analysis has shown that these weeds possess the same fertilising properties as those employed as manure on the French coasts. M. Lavinière calculates that these floating meadows produce annually sufficient vegetable matter to manure 900,000,000 hectares, a hectare being about an acre and a half.—*Revista Industrial, &c.*

Pink Colour and Mineral Lake.—Under the name of pink colour there is met with in the trade, and manufactured by a process which is kept secret, a substance which is chiefly used in this country for painting faience and porcelain. According to M. Malaguti's analysis, this substance is composed, in 100 parts, of—Peroxide of tin, or stannic acid, 78·31; lime, 14·91; silica, 3·96; alumina, 0·95; oxide of chromium, 0·52; chromate of potassa, 0·26; potassa and loss, 0·48. The stannic acid, lime, and oxide of chromium are the essential elements; the silica and alumina are not indispensable; the richness and depth of the colour depends upon the larger quantity of lime and chromate applied in the manufacture. According to M. Gentele, this pink colour may be prepared in the following manner: 1 kilo. of granulated tin is oxidised with nitric acid, and the meta-stannic acid thus obtained is mixed with 180 grms. of bichromate of potassa dissolved in 1 litre of water, and to this mixture there are added 2 kilos. of chalk and one kilo. of finely pulverised glass-sand; these materials are made into a paste, and strongly ignited, after having been placed in a crucible, to a bright red heat; the result of this calcination is ground to an impalpably fine powder, and again ignited, with the addition of carbonate of soda. When a mixture of 100 parts of stannic acid and 2 parts of oxide of chromium is ignited to a bright red heat a beautiful lilac-coloured material is obtained, which is neither injured by daylight nor atmospheric influences, resists the action of sulphuretted hydrogen, and is called by M. Malaguti "mineral lake."

Ink for Writing on Glass.—A solution of fluoride of ammonia is recommended as furnishing a ready means of writing with a pen of any kind upon glass, and is especially adapted for labelling bottles, cylinder-tubes, &c., in the laboratory as well as for marking the degrees upon hydrometers and apparatus of similar construction.—*American Artisan.*

Ashberrium, a New Alloy, consists of 80 parts of tin, 14 of antimony, 2 of copper, 2 of nickel, 1 of aluminium, and 1 of zinc.—*Polyt. Centr.*

New Alloy for Stereotyping.—M. Ed. Hofer-Grosjean recommends the use of an alloy, consisting of lead 50 parts, tin 36, cadmium 225; this alloy is readily fusible, and is harder than the alloy containing bismuth now applied for stereotyping purposes.—*Polyt. Centr.*

Mineral Lemonade.—When equal parts by weight of strong pure sulphuric acid and strong pure alcohol (85 to 90 per cent) are carefully mixed (the acid being poured into the alcohol and thoroughly mixed therewith), a liquid is obtained which has long been known and used by medical men under the older name of *Elixir acidum halleri*, more recently named *Mixtura sulphurica acida*. This fluid, which, if well prepared, contains essentially sulphovinic acid, is an excellent summer beverage when mixed with water in the proportion of one small teaspoonful to a tumbler of cold water, and sweetened with sugar; or, preferably, with some fruit syrup. Above the lemonades made with vegetable acids, this acid mixture has the advantage of not increasing the perspiration, as citric and other vegetable acids do, while, it is better borne by the stomach, and has a tonic action upon the vascular system. It is, indeed, a very pleasant drink, often given, at the *cafés* of Paris, Berlin, Vienna, and other places, along with some *syrop de groiselles* or *framboises*, and rather exorbitantly charged for. The proportions by bulk are—one of strong sulphuric acid and three of alcohol.—*Hamm's Agronomische Zeitung.*

Cellulose in Old Wood.—Mr. Payen has taken the trouble to analyse a piece of old woodwork once belonging to the well-known Chaillot pumps, in order to ascertain what state the cellulose was in, after fully a century's exposure to wind and weather; he therefore treated the wood —first, for eight consecutive days, with a weak solution of caustic potassa (1 part to 10 of water), at a temperature of between 20° and 75° C.; secondly, he treated the residue with nitric acid, sp. gr. 1·2, without applying heat, and also for eight days; next with nitric acid, sp. gr. 1·05, taking care to wash out carefully all substances which, by each of these operations, could have become soluble, previous to proceeding with another operation; M. Payen obtained pure celloluse, as might have been expected, and was evidently also expected by Field-Marshal Vaillant, who happened to be present when the *savant* deposited, at a meeting of the Agricultural Society, a piece of pure celloluse obtained from the wood of the old pump, since the Marshal asked Payen, jocosely, whether he had not some old wood from the ruins of Carthage to operate upon; and M. Robinet, improving upon this occasion, offered to send Payen a piece of wood of Noah's Ark, to continue his researches.

Fusibility and Volatility of Metals.—While engaged with experiments on the intrinsic composition and constitution of various pieces of silver money, made at the Royal Netherlands Mint, at Utrecht, Dr. A. von Riemsdyk carried on some experiments on the fusibility and volatility of metals, from the published record of which we abstract the following:—The metals tin, bismuth, cadmium, lead, and zinc, as chemically pure as they can be obtained, were molten, in order to prevent their oxidation, in a feeble, but constant, current of pure and dry hydrogen gas. The author found that—(1) the melting of these metals does not, either mechanically or by evaporation, give rise to any loss at all; (2) that *tin*, *lead*, and *bismuth*, when kept in a liquid state, are not volatile at temperatures greatly in excess of their melting points, and that, at a bright red heat, quantities of 2·3433 grms. of *bismuth*, and 4·5183 grms. of *lead*, did not lose, by being kept at that temperature for one hour, more than 1 and 0·5 m.m., respectively, by evaporation, while *tin* did not exhibit any volatility at all; (3) that *cadmium*

and *zinc*, though completely fixed, non-volatile, at their melting point, begin perceptibly to volatilise at a few degrees above that point; (4) that there does not exist any relation at all between the fusibility and volatility of these metals, which may be arranged in the following manner, beginning from the most fusible and most readily volatile:—

Fusibility.		*Volatility.*
Tin	228·5° C.	Cadmium.
Bismuth	268·3° "	Zinc.
Cadmium	320·0° "	Bismuth.
Lead	326·0° "	Lead.
Zinc	420·0° "	Tin.

(5) that the so-called Rose's fusible metal, an alloy of tin, lead, and bismuth, the melting point of which is about 97·5°, and certainty not higher, is not perceptibly volatile when heated to a bright red heat in a current of pure hydrogen gas. Silver, unalloyed, melts at 1040° C., pure gold at 1240° C., while the author found that chemically-pure copper requires a temperature of 1330° C. to become liquid. Neither pure silver, nor pure copper, nor also the alloy of silver and copper containing 945-1000ths of the former metal (this alloy is the standard alloy of the Netherlands silver coins), loses anything at all by volatilisation when kept for a considerable time at temperatures higher than the melting points of both these metals, and in a feeble current of pure hydrogen to prevent their oxidation. The author has made some of these experiments on a very large scale, having at his disposal large quantities—several hundred kilos.—of these metals in pure and alloyed state; he also describes an ingenious pyrometer devised and invented by him, but space forbids us to enter into further details.

Alkaloid Formed during Alcoholic Fermentation.—M. Oser has instituted researches with pure sugar brought into fermentation, and, after a series of operations, has succeeded in obtaining an alkaloid composed according to the following formula:—$C_{13}H_{20}N_4$. The hydrochloric acid combination has the formula—$C_{13}H_{20}N_4HCl$; the combination with chloride of gold is expressed by $C_{13}H_{20}N_4AuCl_4$. The author states that this alkaloid is positively the result of fermentation; but he also intimates that, since older wines contain, according to Ludwig's researches, trimethylamine, it is probable that the alkaloid here alluded to is either decomposed in older wines, or is only met with therein in very minute quantities.—*Polyt. Centr.*

Estimation of the Goodness of Soap.—Prof. Schültze, of Rostock, starting from the view that, the better the soap the less thereof will be required for the entire unhardening of water, employs the reverse of Clark's process, in the following manner:—He applies a solution of lime in water containing excess of carbonic acid, so that a litre of water contains exactly 1·6 grm. of lime. Of this fluid he takes 3 c.c. (containing, accordingly, 4·8 milligrms. of lime), and adds 20 c.c. of water, and a small quantity of soda solution; he further applies an aqueous solution of 5 grms. of soft soap in 100 c.c, or of the same quantity of solid soap in 200 c.c., of water, and adds of these solutions from a burette to the aforesaid lime solution until a lather is fully and completely formed. The smaller the quantity of soap solution required for this purpose, the better, of course, the soap is; and it is easy to calculate how much of the soap solution has been required for one part, by weight, of lime; a perfectly pure soap, however, will be required, for comparison's sake.

Nitroglycerine.—The only safe and proper mode of permitting the use of this substance is, undoubtedly, that adopted in France, Southern Germany, Belgium, and the United States, that is, to allow its use only on the absolute condition that it be made on the very spot where it is wanted, and be only made in quantities sufficient for, at most, three days' sufficient supply. In an article which appeared in the Chemical News, No. 422, vol. xvii., p. 11 (January 3, 1868; *Am. Repr., March*, 1868, *page* 102), on this subject this point was briefly alluded to; and the experience since obtained in the countries above-named, the United States being foremost in this matter, has fully proved the utility of this rule. Nitroglycerine making is readily taught to workmen, and, with some care, succeeds exceedingly well. There is no sound reason why this plan should not be adopted in this country too.

Hygrometer.—Naudet and Co., Paris, Rue et Place Thorigny, 2 and 4, have constructed a portable hygrometer, shaped like a watch. The measuring of degree of moisture is effected by means of a peculiarly-prepared human hair, 0·35 metres long. The mechanism is graduated by placing the instrument under a bell-jar, wherein the air is kept dry by means of recently burnt quick-lime and fused chloride of calcium; and next it is placed under a bell-jar wherein the air is kept saturated with moisture by means of a wet sponge. The distance between these two extremes, indicated by a properly-constructed mechanism, is divided into 100 parts. The price of this instrument, which is highly spoken of, is 25 francs (£1). It is intended for use in spinning and other establishments, and for observations. —*Deutsche Ind. Zeitung.*

Indelible Ink.—Two solutions are required—No. 1 consisting of—Crystallized chloride of copper, 8·52 parts; chlorate of soda, 10·65 parts; and chloride of ammonium (sal ammoniac), 5·35 parts, to be together dissolved in 60 parts of distilled water. No. 2 solution, consisting of 20 parts of hydrochlorate of aniline, to be dissolved in 30 parts of water, to which has to be added 20 parts of a solution of gum (made by dissolving one part, by weight, of gum in two parts of water), and, lastly, 10 parts of glycerine. These solutions are kept in separate bottles. When it is required to write anything with these fluids, one part, by bulk, of solution No. 1 is mixed with four parts, by bulk, of No. 2. The ink must be applied to paper, linen, cotton, wool, or silk, with a quill pen, or small hair brush; at first, the writing appears greenish, but it soon becomes black, especially if it is exposed to a higher temperature. This writing is perfectly indelible, and can only be destroyed by destroying the fabric it is placed on.—*Dr. Artus's Vierteljahreschrift.*

Production of Oxygen for Industrial Uses.—The works, in running order, although not yet quite finished, are located at the foot of Forty-first Street, in this (New York) city, a malodorous neighbourhood, where some means, artificial or otherwise, would not be out of place in substituting oxygen for the foul emanations of butchers' shops and dirty gutters. The essential or characteristic portions of the process are carried on by the aid of brick furnaces, of which only one was in operation at the time of our visit, several others being, however, rapidly put up and fitted for use. Each furnace has its fire-box so arranged as not only to heat the retort which holds the manganate of soda (the vehicle through which the process is carried on), but also one or more chambers through which an air-blast passes to the retort. The retort, furthermore, communicates, by a pipe furnished with stop-cocks, with a suitable steam-boiler. The process is carried on as follows:—About 600 pounds of manganate of soda are placed in the retort, heated to the requisite degree in the furnace; superheated steam from the boiler is then admitted for about ten minutes. Two equivalents of the manganate of soda and two of water react upon each other, as indicated by the formula—

$$2(MnO_2,NaO)+2(HO)=2(NaO,HO)+Mn_2,O_3+O_2.$$

In other words, the water combines with the soda of the manganate to form a hydrate of soda. The manganic acid is changed to sesquioxide of manganese, containing only half the proportion of oxygen, and the other half of the latter passes off in a free condition. At the conclusion of this part of the process, the steam is shut off, and the superheated air is admitted for about fifteen minutes, whereupon the sesquioxide combines with more oxygen from the air and is converted back into its original form of

acid, which, of course, resumes its former relation to the soda, reconstituting manganate of soda, ready for a repetition of the process. In forcing the air to the apparatus, a steam-pumping engine is used, noticeable for the manner in which friction gearing is applied to transmit power from the engine to the air-forcing pumps, without the jar incident to the use of cogged wheels. The air-blast passes first through cylindrical vessels containing caustic soda, by which its carbonic acid is removed, and thence through the superheating chamber previously mentioned, to the retort. The retort is never opened, as the material shows no signs of deterioration by use. That in the retort, at the time of our visit was tested continuously for six months before being brought to this country, and has been in constant use for six weeks past, the period during which the works have been in constant operation. As the oxygen leaves the retort it passes through a suitable meter, which registers the quantity, and thence to the gasometer, which, at the present time, contains 25,000 feet of oxygen gas, much purer than is required for most of the purposes for which it is to be employed.—*American Artisan.*

Preservation of Protosulphate of Iron.—M. Welborn states that protosulphate of iron is absolutely preserved and kept from even the very least trace of oxidation, by placing with it a piece of camphor wrapped in a piece of clean and dry paper.—*Deutsche Ind. Zeitung.*

Preservation of Meat.—M. Georges recommends to place the meat into a bath containing 86 parts of water, 10 parts of common salt, 4 parts of glyceric acid or *acide vineux* (glyceric acid is prepared by the author by mixing equal parts of glycerine, water, and hydrochloric acid; *acide vineux* is made in the same way, but instead of glycerine alcohol is added); after this fluid has become thoroughly soaked into the meat it is pressed and squeezed, and next covered with a layer of fat.—*Deutsche Ind. Zeitung.*

Action of Carbolic Acid on Reptiles.—We have been favoured with extracts from an account of some very valuable experiments made by J. Fayrer, F.R.S.E., C.S.I., &c., on the value of carbolic acid in preventing the entry of serpents into dwellings, from which we find that a few drops of the acid are sufficient to quickly kill full-grown cobras and other poisonous snakes. Dr. Fayrer is continuing his experiments on the merits of carbolic acid as a therapeutic agent in snake bite, and, in the meantime, he suggests its use as a preventive against the entry of snakes into houses, &c. Dr. Calvert informs us that it is probable that the acid will save life by applying it, in a caustic state, to the wound caused by the bite of a serpent, and more satisfactory results will be obtained by following the method first put into practice by Dr. Tessier in the Mauritius, for the cure of a virulent intermittent fever. In this case, by injecting under the skin a solution of three-quarters of a grain of carbolic acid dissolved in 20 minims of water, the patients were rapidly cured, and the spread of the pestilence arrested.

Experiments with Flame.—Dr. Hofmann, F.R.S.—Take a piece of canvas, such as is used by ladies for Berlin wool work, and put it on to the top of the superior opening of the glass chimney of an argand gas burner, taking care to envelope the glass chimney previously with a very thin piece of copper foil, while the access of air at the bottom of the burner should be as much as possible prevented. On turning the gas on, it escapes readily through the small openings in the canvas, and the gas may be ignited above. The canvas, however, soon takes fire and burns off, but leaves a very complete circular disc, which remains white and unconsumed in the centre of the frame. If it is desired to demonstrate more completely the nature of the flame, it is done by placing, on the middle of the canvas disc, some gunpowder, and on it the heads of some lucifer matches. After having again turned on the gas, and left it to escape for a few moments, it may be kindled again, and will burn quietly, and even though, as in the first experiment, the excess of canvas again burns off, neither the gunpowder nor matches will catch fire until just at the moment the gas is gently turned off. In order to exhibit the reducing action of the interior portion of a Bunsen gas flame, a spirally rolled-up piece of copper wire is held in the interior portion of the flame by means of a pair of forceps. When this spiral is taken out of the flame while red-hot, and exposed to contact of air, it becomes covered with a black coating of oxide of copper; but if the spiral, instead of being taken out of the central portion of the flame, is lowered down into the current of gas, and there cooled, it will exhibit, on withdrawal, a clean and bright metallic surface.—*Berichte der Deuts. Chem. Ges. zu Berlin.*

Quantity of Water contained in Illuminating Gas.—During the months of February and March of the current year, the author (A. Vogel) instituted on various days, and at different hours during the day and night, experiments with the gas taken directly from the mains of the Munich Gas Works. By causing a slow current of the gas to pass through chloride of calcium tubes, the author found that the quantity of water contained in the gas varied from 0·06 to 0·11 grm. to the cubic foot; it is evident that this quantity may, and naturally will vary according to circumstances. Dr. Vogel next made a current of gas pass through glass tubes placed in a freezing mixture; in this manner he obtained a quantity of ice formed by the freezing of the water contained in the gas; the water obtained on melting this ice had no action upon test papers. By means of Nessler's test, after previous addition of some caustic potassa to the water, ammonia was very clearly indicated to be present. Cyanogen was found therein, by means of Schonbein's test-paper for this substance. When tested with indigo-carmine and sulphuric acid, the decolouration of indigo is observed, while an odour of nitrobenzol is emitted. It hence appears that there is nitrate of ammonia present, and that this is one of the products of the distillation of coal.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

Testing Bees'-Wax.—It appears that both yellow and white bees'-wax is met with in the trade largely adulterated with paraffin. In order to detect this, the following process is recommended:—2 grms. of the wax to be experimented upon are placed in a test-tube; and there is added a solution consisting of 1·5 grms. of solid caustic potassa in about 5 grms. of distilled water, and the mixture boiled, care being taken to shake the test-tube now and then, whereby a thorough though not quite clear mixture is produced. When the fluid has cooled so far down as nearly to reach the point of solidification of the wax, from 6 to 8 grms. of light oil of petroleum is gradually added, and this thoroughly incorporated with the entire mass, so as to form an emulsion, from which, if well made, the light oil does not separate. Next, an excess of an aqueous solution of acetate of lead is added, which is mixed with the mass by stirring with a glass rod. The addition of this lead salt causes the separation of the light oil of petroleum, and in it will be dissolved any paraffin present in the wax. The same operation is twice repeated with the contents of the test-tube, that is to say, petroleum is again and again added, and allowed to separate; the separated petroleum is placed into a retort, and the light oil removed by distillation. Pure yellow wax loses, by this process, from 14 to 16 per cent; but wax has been met which lost 57 per cent in weight; the specific gravity of the residue of adulterated wax was 0·88. When it is desired to obtain the paraffin in a pure state freed from any dissolved wax, this may be effected by cautiously decomposing the wax supposed to be adulterated with paraffin, by means of fuming sulphuric acid, which does not affect paraffin.

The Zirconia Light.—The oxygen process of M. Tessie du Mothay, according to the Paris correspondent of the *British Journal of Photography*, consists in heating, in iron retorts divided in two by a horizontal grating, a quantity of manganate of soda. This is heated to a dull red, and a cur-

rent of superheated steam is made to pass over the mass. Oxygen is given off in abundance, and passes along with the current of steam into a refrigerator, where the steam is condensed into water, and the oxygen is afterwards collected in a gasometer. When no more gas comes off, the manganate is exhausted. The next operation is to re-oxygenise the exhausted manganate. This is accomplished by passing heated *air*, not steam, over it, when the manganate absorbs the oxygen, and becomes as ready as ever for yielding it again to the vapour of water. Thus, the two operations can go on for an indefinite time, the air being the source of supply of oxygen. It has been found that carbonic acid gas is detrimental to the production of oxygen, and so the air is deprived of this before it acts upon the manganate of soda. One advantage claimed by the advocates of the zirconia cylinders, besides their durability, is that a mixture of *equal* parts of oxygen and carburetted hydrogen can be used instead of a mixture in which oxygen is in excess, as is usual. The magnesia for the magnesian cylinders must be very pure, and free from silica, or they will not be durable under heat.

Manufacture of Sugar.—*The Journal des Fabricants de Sucre* states that experiments are now in progress in some French colonies to try, on a large scale, Messrs. Rousseau and Bonnaterre's plan of converting the saccharine juice of cane or beet-root into a peculiar saccharate of lime, and to transport that salt, instead of raw sugar, for the purpose of refining. It is said that this compound is as hard as sand, and can be transported without the risk of damage and injury sugar is subject to, and be kept for any length of time.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers on a level with the latest advances of science.*

NOTE.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Comptes Rendus des Séances de l'Académie des Sciences (No. 25), June 21, 1869.

Omitting the purely astronomical, mathematical, and other memoirs and papers of no direct interest to the readers of our paper, we notice a memoir—

On a Homologue and Isomer of Choline.—M. Wurtz.—The author says—Some time ago I pointed out that, when chlorhydrate of glycol fixes and combines with trimethylamine, the result is the formation of a new basis identical with neurine as obtainable from brain. Since the identity of choline, which M. Strecker has extracted from liver, and the base just alluded to, has been proved, I shall call neurine henceforward choline. The reaction above mentioned is represented by the following formulæ:—

$$\underbrace{(C_2H_5)_3N}_{\text{Triethylamine.}} + \underbrace{C_2H_4\left\{\begin{matrix}OH\\Cl\end{matrix}\right.}_{\text{Chlorhydrate of glycol.}} = \underbrace{\left.\begin{matrix}C_2H_4.OH\\(C_2H_5)_3\end{matrix}\right\}NCl.}_{\text{Chlorhydrate of hydroxethylentriethylammonium.}}$$

This salt is soluble in water and alcohol, crystallises in prisms, and yields, with chloride of platinum, a crystalline double-salt made up according to the following formula:—

$$\left[\begin{matrix}C_2H_4.OH\\(C_2H_5)_3\end{matrix}N.Cl.\right]_2 + PtCl_4.$$

The hydrate of hydroxethylen of triethylammonium, $C_8H_{21}NO_2$, is evidently a homologue of chinoline, $C_9H_{15}NO_2$. The author's paper describes, at very great length, the preparation of many complex compounds like those named, and, lastly, promises a detailed account of this portion of his labours.

Some Isopropylic Compounds.—M. Da Silva.—Butyrate of isopropyl is a colourless liquid; odour disagreeable; boils at 128° C.; is inflammable, and burns with a bright flame. Its vapour density is 4·73.—Valerate of isopropyl is also a liquid, colourless, inflammable, of a disagreeable odour, and of less density than water. Its specific gravity, at 0° C., is 0·8702; vapour density, 5·004; and boils at 142° C.

Coal-Tar Oils which Boil at about 200° C.—M. Romier.—The author says—Having obtained, through the kindness of the chief engineer and chemist of the United Parisian Gas Works Company, M. Audouin, 16 litres of heavy coal-tar oil, I have therefrom obtained about 4 litres of oil, perfectly freed from naphthaline, phenol, and alkaloids, and boiling at between 170° and 225° C. Leaving out of the subject of his research all fluids contained in the aforesaid 4 litres boiling below 176° C., and which in bulk represented 3½ litres, the author has obtained three oils of constant boiling point, respectively boiling at between 176° and 179°, at between 196° and 198°, and, lastly, at between 200° and 225° C. These oils are colourless, lighter than water, and exhibit an odour reminding one of that of oil of turpentine; they have been submitted to a series of experiments; and the author states that they are cymens and hydrides of formen.

Analysis of the Meteorite of Kernouve, near Cleguerec, Morbihan, Fallen on the 22nd of May last.—M. Pisani.—The entire weight of this mass, before it was broken up, was about 80 kilos.; the piece from which a portion has been applied for analysis weighed 16 kilos. The specific gravity of this meteorite is, on an average, 3·747. The result of the analysis, in 100 parts, was as follows:—Iron, 22·25; nickel, 1·55; sulphur, 2·15; copper, a trace; chromate of iron, a trace; silica, 32·95; alumina, 3·19; protoxide of iron, 11·70; magnesia, 23·68; lime, 1·89; soda, with traces of potassa, 1·41.

Polytechnisches Centralblatt, No. 9, May 1, 1869.

We do not propose regularly to quote this periodical, which is chiefly devoted to mechanics and engineering; but whenever it happens to contain either original papers of interest to our readers, or, as now and then occurs, abstracts of interest from German, Swedish, or Russian periodicals, which from their limited circulation have not become generally known, we shall make the necessary abstracts.

Ready Method of Preparing Phosphuretted Hydrogen Gas.—Dr. H. Schwartz says, When the pulverulent metallic zinc which is deposited in the tubes of the Belgian (Vieille Montagne) zinc smelting furnaces, is mixed with amorphous phosphorus in powder, in the proportion of one part of zinc to two of phosphorus, and this mixture, after having been introduced into a hard-glass combustion tube, is gently heated therein, while, at the same time, a current of dry coal gas or dry hydrogen gas is passed through the mixture, phosphide of zinc is formed; it is necessary to cool the tube and mixture while the current of gas remains turned on. From the phosphide of zinc so obtained phosphuretted hydrogen may be readily prepared by means of dilute sulphuric acid, or by boiling with caustic potassa solution; the gas evolved is, however, the non-spontaneously combustible kind; the spontaneously combustible gas may be obtained by applying a larger quantity of the phosphide of zinc and warm dilute sulphuric acid.

Analysis of some Colouring Substances used for Staining Glass and Faience Ware.—Dr. H. Schwartz.—A bright brown colour was found to consist in 100 parts of —Oxide of chromium, 11·30; peroxide of iron, 21·00; alumina, 18·02; oxide of zinc, 50·90; this material may be prepared as follows: 71 grms. of chrome alum; 60 grms. of persulphate of iron; 160 grms. of alum, and 180 grms. of sul-

[English Edition, Vol. XX., No. 499, pages 310, 311, 302; No. 501, pages 11, 12]

phate of zinc, are dissolved in water, and after having been mixed, precipitated by means of carbonate of soda, collected on a filter, washed, dried, gently ignited, and rubbed to powder in an agate mortar; a reddish brown colour consisted in 100 parts of—Oxide of barium, 19·82; oxide of chromium, 11·07; peroxide of iron, 7·70; alumina, 2·30; silica, 10·40; sulphuric acid, 5·47; carbonic acid and alkali, 3·81.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiii.

This periodical contains only one paper relating to chemistry—A memoir, or rather, and more correctly, a fresh instalment of a memoir:—

On Hydrocarbons.—M. F. Fritzsche.—(Read at the meeting of the 4th of February last). The author says, I call Photen the substance $C_{14}H_{10}$, fusing at 210° C.; in pure state it is always a somewhat yellowish-coloured solid, soluble in very strong alcohol, exhibiting in solid as well as in a fused state a violet fluorescence. Phosen, another hydrocarbon, fuses at 193° C.; by the action of sunlight this substance is entirely altered in its properties, and the so-altered matter is called paraphosphen by the author; by simple fusion this latter is again converted into phosen. The author describes at great length the preparation in pure state of the two substances alluded to, discusses their crystallographical properties; describes oxyphoten $C_{14}H_8O_2$; oxybinitrophoten, dioxyretisten $C_{16}H_{14}O_2$; but these descriptions and the record of the properties, and mode of preparation of these substances, are so lengthy, and, moreover, so interspersed with discussions on other, although not in this respect quite irrelevant, matter, that it is impossible to give a condensed abstract which will do justice to the author.

Comptes Rendus des Séances de l'Académie des Sciences (No. 26), June 28, 1869.

We observe, in the first place, that Sir Roderick Murchison was present at this meeting of the illustrious scientific society of France, of which he has been elected a Foreign Member; being present for the first time after his election, he was most heartily received by the large number of *savants* present. The speech made by the celebrated British geologist was the signal for M. Dumas to say a few words, highly eulogising the excellent reception given to him while lately at London, and stating that, in the person of one of their perpetual secretaries, the British scientific world and renowned *savants* had honoured and fêted the Academy. We notice the following papers:—

Mode of Condensing Magnetism Analogous to the Condensation of Electricity.—M. Jamin.—The author has caused M. Limet to make for him a horseshoe-shaped magnet, made up of ten bars of perfectly homogeneous steel, and fastened together by means of bolts. When this artificial magnet is properly magnetised, it is capable of bearing a weight of 300 kilos. at the armatures. When this armature is placed so as to be only in contact with one of the steel bars composing the horseshoe, it appears that the magnetism of the nine other bars is very perceptibly diminished. Under these conditions, and, notwithstanding the magnet was previously already saturated with magnetism, it is possible to saturate anew with magnetism, and make the horseshoe bear again 600 kilos. This experiment can be repeated: another armature may be put on, so as to bear only upon one of the component bars, and, again, more magnetism can be condensed. The learned author has already succeeded in making the horseshoe bear another 680 kilos. in this manner.

Researches on the Oxygenated Bases—Action of Chlorhydric Glycol on Toluidine.—M. Wurtz.—This is another instalment of the papers resulting from the author's labours on this subject. The paper here alluded to contains researches on the action of chlorhydric glycol upon aniline and toluidine. When a mixture of aniline and chlorhydric glycol are heated together on a water-bath, a thickish and coloured liquid is obtained, which yields, with a concentrated solution of chloride of platinum, a very unstable, readily-decomposable salt. When the mixture of substances just alluded to is heated in an air-bath to from 195° to 210°, and the fluid afterwards treated with water, and filtered, an abundant precipitate is formed with a concentrated solution of chloride of platinum. This salt, having been well purified, yields, on analysis, results leading to the formula—

$$(C_{17}H_{19}ON.Cl)_2,PtCl_4.$$

When toluidine is thus acted upon by chlorhydric glycol, the author obtains three bases—(*a*) vinyltoluidine—

$$C_9H_{11}N=C_2H_2\left\{\begin{matrix}C_7H_7\\H\end{matrix}\right\}N;$$

(*b*) two other bases of complex composition, containing no longer toluyl, but the radical C_7H_7, toluenyl; while one of these bases contains, besides toluenyl, also two vinylic groups.

New Researches on Hydrogenium.—Mr. T. Graham.—From this paper we quote, in the first place, that the author finds the specific gravity of hydrogenium to be 0·872. The eminent *savant* records in this paper, consecutively, researches on—*palladium, platinum, and hydrogenium; palladium, gold, and hydrogenium; palladium, silver, and hydrogenium; palladium, nickel, and hydrogenium.* We give these researches in a separate paper on another page.

Poisonous Effects of Coralline.—M. Landrin.—This paper, or report, rather, contains the results of the researches made at the request of the celebrated Dr. Tardieu, and the members of the Academy of Medicine. The result of carefully made experiments, also by giving large doses of coralline to animals and applying it to their skin, is that coralline is no poison at all, whether internally or externally applied; and its use in dyeing is quite harmless, provided it be not mixed with substances which are very decided poisons.

Certain Stellar Spectra.—M. Janssen, in a letter dated from Darjeeling, Sikim, British India, 22nd May last, says that the spectra of some stars, which are rather ruddy-coloured when not disclosing the presence of hydrogen, do positively disclose the presence of aqueous vapour.

Spectra which some Compound Substances Exhibit when Produced within Gaseous Mixtures which are in a state of Equilibrium.—Messrs. Berthelot and Richenau.—This paper is not suited for proper abstraction.

Presence of Peroxide of Hydrogen in the Atmosphere.—M. Struve.—The author, writing from Tiflis (a large town on the Caucasian side of Russia), calls attention to some interesting facts observed by him in reference to the quantity of nitrite of ammonia, ozone, and oxygenated water (peroxide of hydrogen) present in rain-water, and water obtained from melting snow and hail. The author applies oxide of lead as a test, which is converted into peroxide. M. Sainte-Claire Deville reminded the meeting that, while—in July and August, 1859—he was engaged in making some researches (he was, during that time, staying on the St. Bernard); on ascending two mountain tops, named Le Vélan and Le Combin, respectively 3762 and 4430 metres high, he collected there rain and snow water, which, on being analysed by M. Boussingault, was found to contain so much ammonia and nitric acid that, were it not that several bottles of the same sample were taken, it might have appeared as if bottles which were not well cleaned had been applied for collecting the fluids.

Heat of Combination of Hydrosulphuric and Hydroselenic Acids.—M. Hautefeuille.—This paper is too abstruse for condensation.

Theory of Etherification by means of Hydrochloric Acid.—M. Friedel.—When it is desired to obtain

a compound ether, the mode of obtaining it often resorted to is, to mix the acid of which it is desired to have the ether with alcohol, and to pass through this mixture a current of hydrochloric acid gas. The author proves that, in that case, there is formed first a chloride of the acid radical, and that that chloride afterwards gives rise to the formation of the compound ether. The author describes at length a process whereby it is possible to obtain, by the action of hydrochloric acid gas upon benzoic acid, chloride of benzoyl.

Primitive Normal Butylic Alcohol.—Messrs. Lieben and Rossi.—This lengthy paper contains the results of experiments made by the authors to prove that a compound discovered and described by M. Wurtz as a butylic alcohol, in the year 1850, is only an isomer of the true and genuine butylic alcohol obtained in a peculiar manner, described at great length by the authors, and wherein an aldehyde plays an important part. We conclude these abstracts by simply quoting the titles of the following papers, which are either purely physical, or are not well suited for proper abstraction with due justice to their contents, and the labours bestowed thereupon by their authors:—

Compressibility of Liquids.—Messrs Amaury and Descamps.

Measure for the Conductive Power for Electricity of such Fluids as are Generally Hitherto considered as Non-Conductors.—M. Said Effendi.

Alcoholic Fermentation Excited by the Microzymas of the Liver.—M. Béchamp.

Toluylen-Diamine.—M. G. Koch.

Researches on Inuline and the Acetic Acid Derivatives therefrom.—Messrs. Ferrouillat and Savigny.

Deutsche Industrie Zeitung, May 24, 1869.

Detection of Arsenical Pigments.—M. C. Puscher states—That during the first five months of this year, no less than eight cases of accidental poisoning by these pigments have occurred at Nüreuberg; he advises the use of liquid ammonia for the detection of these pigments, all of which, he says, are soluble therein, exhibiting a blue-coloured solution, if copper is at the same time present; he further states that, on the evaporation of the ammonia, there remains a dirty greenish-coloured precipitate of arsenite of oxide of copper; his advice is to paint some *white* paper with this solution in ammonia, which painting, when dry, if arsenic were present, will exhibit a dirty-greenish colour, but if after drying a blue colour appears to have been imparted to the paper, the pigment is quite free from arsenic, and only consists of a compound of copper, of which latter metal there are several in use, as green and blue pigments, all soluble in ammonia, except such adulterations as do not essentially belong to the pigment itself.

The Journal of the Franklin Institute (No. 4), April, 1869.

We notice from this paper the following communications and papers:—

Spectrum Lines, a New Method of Illustrating them.—At a late meeting of the American Institute, Professor E. C. Pickering, of the Massachusetts Institute of Technology, employed the following method to illustrate his paper on spectrum analysis. A sheet of black lace, 1½ ft. broad and 3 ft. high, was suspended as a screen, and upon it was thrown a continuous spectrum from a magnesium light, arranged in the manner first developed for electric light by Professor Cooke, of Cambridge, U. S., except that only one bisulphide of carbon prism was used. The spectrum covered the entire lace screen, the curvative of its lines being corrected by an opposite curvature of the opening through which the light passed. Upon this black lace were attached a number of strips of white paper, so arranged as to occupy the places of the bright lines in seven different spectra, such as those of sodium, potassium, rubidium, cæsium, &c. These being illuminated by the variegated light of the continuous and broad spectrum, received and reflected each colour corresponding to its position, and, therefore (their adjustment being accurate), that which actually belonged to the band which it represented. The light falling between these paper bands was, of course, not reflected, and the appearance, therefore, was in each case (as in an actual spectrum) that of bright-coloured lines on a dark ground. When, however, as in the case of potassium, the nebula of Orion, &c., a faint continuous spectrum is, in fact, combined with that of the bright lines, this, also, was represented by attaching, in the required places, bands of white lace, which reflected enough of the coloured light to produce a hazy spectrum, admirably imitating that of the substances or bodies in question.

Acid-Proof Cement.—R. F. Fairthorne.—It frequently happens that the chemist requires some means for protecting cork from the destructive action of vapours such as arise from boiling nitric acid; the author found the following plan to meet this requirement:—Finding it necessary to connect a glass tube with a wide-mouthed flask, and, in so doing, to use a cork, which was exposed to the action of the fumes from boiling nitric acid for several hours, the author found the best preservative to consist of a coating of silicate of soda and powdered glass. The cork, having been bored to suit the size of the tube, was soaked for two or three hours in a solution of silicate of soda, consisting of one part of commercial concentrated solution to three parts of water. The tube was next inserted, and, when dry, the cork was covered with a paste, made by mixing the concentrated solution of the silicate with powdered glass, in such proportions as to form a mass of about the same consisteucy as that of putty. This is spread on the under surface, and then washed with a solution of chloride of calcium. It soon hardens; so that it is advisable to make the connection with the flask whilst the paste is in a plastic state, and to allow it to become solid before applying heat to the vessel containing the acid. Corks protected in this manner were but slightly acted upon after remaining over the boiling nitric acid more than four hours, and over hot acid for ten. The cement, the preparation and use of which is herein described, is very useful for general use as a luting for chemical apparatus.

Hot-Cast Porcelain.—Charles P. Williams.—This is the trade name of a peculiar tough, milk-white, translucent glass, not unlike French porcelain in appearance, and extensively made at Philadelphia and Pittsburgh, U. S. It is intermediate in character between the glasses produced by the addition of phosphate of lime to the ordinary glass materials, on the one hand, and the white enamels, such as are produced by oxide of tin on the other, having more of the milkiness than the former, and less opacity than the latter. The raw materials consumed in its production are sand, oxide of zinc, and cryolite, which are melted together in the ordinary clay pots of the glass-maker. The following is the composition of an average sample of this glass, taken when the "metal" was in its best working condition:—Silica, 63·84; alumina, 7·86; peroxide of iron, 1·50; protoxide of manganese, 1·12; oxide of zinc, 6·99; lime, 1·86; magnesia, 0·25; soda, 10·51; fluorine, 8·05; [less oxygen (corresponding to the fluorine), 3·39]=98·59 for 100 parts. The above is the mean of five analyses. The method pursued in the above analyses consisted in fusing the compound with carbonate of soda, extracting with water, and, after precipitating the silica and alumina in the aqueous solution by means of carbonate of ammonia, separating the fluorine as fluoride of calcium mixed with carbonate of lime, by the addition of chloride of calcium. The mixed salts were afterwards treated with acetic acid, and the separated fluoride of calcium, dried, burned, and weighed. The remainder of the analyses was conducted as is usual in the analysis of silicates, the alumina and oxide of iron being precipitated as basic acetates, and separated, after weighing, by means of tartaric acid and sulphide of ammonium. Admitting the fluorine to exist in the glass in the condition of silico-fluoride of sodium

(NaF,SiF_2), the following formula will express the composition of the compound:—

$$2[R_2O_3 3SiO_2 + 3(RO 3SiO_2)] + NaFSiF_2.$$

Zeitschrift für Chemie, von Beilstein, No. 9, 1869.

The original papers contained in this periodical are—

Monochlorocrotonic Acid and its Salts.—M. O. Froelich.—When two parts by bulk of perchloride of phosphorus act upon one part, by bulk, of ethyldiacetic acid, two new acids containing chlorine are formed; both are crystalline, and they are isomeric with each other; only one of these acids, the monochloroacetic acid,

$$C_4H_3ClO_2, (C=12, O=16),$$

has been further investigated; the pure acid is a solid substance, exhibiting crystalline structure, fusing at 59°C.; becoming solid again at 55° C.; boils at 194·8° C.; it is a rather volatile substance, prone even to sublime when kept in closed bottles, at the ordinary temperature of the air. It is not very soluble in water; at 7° C. one part of the acid requires 79 parts of water for solution; readily soluble in ether and alcohol. It is a rather powerful acid, easily decomposing carbonates. The author has prepared a series of salts of this acid with alkaline, earthy, and metallic bases: the potassa salt, $C_4H_4ClO_2,K+H_2O$, is crystalline, like almost all of the salts this acid forms. Monochlorocrotonic acid-ethyl ether, $C_4H_4ClO_2(C_2H_5)$, is a colourless, oily fluid, possessing an aromatic odour and a cooling taste, boils at 161·4° C. Its specific gravity at 15° C. is 1·113. Slightly soluble in water, readily in alcohol and ether; does not affect the vegetable colours, as, for instance, litmus. The methyl-ether analogous with the preceding—

$$C_4H_4ClO_2(CH_3)$$

is an oily fluid boiling at 142°; its specific gravity at 15° is 1·143. Insoluble in water, less soluble in alcohol than the preceding.

Presence of Peroxide of Hydrogen in the Atmosphere.—M. H. Struve.—The author, writing from Tiflis, Central Russia, states that his observations and researches of the water of the river Kurr, after a heavy rain or snow-storm, led him to detect therein first, ozone, next peroxide of hydrogen, and afterwards nitrite of ammonia. In order to detect peroxide of hydrogen in rain or snow-water, the author adds to 25 c.c. of water, 5 drops of a clear iodide of potassium and starch solution, and next a single drop of a solution of sulphate of protoxide of iron and ammonia. When only traces of HO_2 are present, a blue colouration soon ensues, but soon also disappears. The author has not made any quantitative researches, but he avers that, owing to the presence of HO_2 in the water obtained from snow and rain, at Tiflis at any rate, and in that portion of Europe, peroxide of hydrogen may be present.

On some Derivatives from Methylen.—M. Butlerow.—Chloride of methylen, CH_2Cl_2, was prepared from pure iodide of methylen, by passing a current of chlorine through it while placed in a distilling apparatus under water, and a long-continued purifying process; the chloride of methylen is a colourless, very mobile fluid, exhibiting a smell akin to that of chloroform, and like that endowed with a sweet, burning taste. Chloride of methylen is somewhat soluble in water; its specific gravity is at 0°C. 1·3604; it consists, in 100 parts, of—C, 14·12; H, 2·35; Cl, 83·53. Hexamethylenamin is the result of the action of oxymethylen and ammonia upon each other; this base yields with hydrochloric acid a crystalline compound, $C_6H_{12}N_4Cl$.

Bromated (Gebromtes) Toluidin.—When it is desired to prepare bromated aceto-toluidin, the latter substance is placed in a vessel and water is poured over it, and next [illegible]ne is added in small quantities at the time; the mono-aceto-toluid, $C_7H_6BrN(C_2H_3O)H$, is a solid, crys- needle-shaped crystals, difficultly soluble in water, alcohol; fuses at 117·5°C.; bromated-toluidin as liquid, boiling at 220°C., insoluble in water; specific gravity 1·510 at 20°C. The nitrate of this last compound, $C_7H_6Br.NH_2.HNO_3$, is a beautifully crystalline substance, not readily soluble in water, fusible at 182° C., but at the same time becoming decomposed.

Action of Sulpho-Chloride upon the Bromide and the Iodide of Ethyl.—M. E. Wroblevsky.—SO_2HCl does not exert any action at all upon $C_4H_4Br_2$ until the heat of a water bath is applied; HBr and Br then escape. After dilution with water, neutralisation with $BaCO_3$, and a careful evaporation, the author obtained a salt, $(C_2H_4Br.SO_4)Ba_2$. SO_2HCl acts very energetically upon C_2H_5I, while, thereby, separation of HI and I takes place. When SO_3, anhydrous sulphuric acid, is made to act upon $C_2H_2Cl_2$, and the product was saturated with baryta, the barium salt was obtained of a very unstable chlorinated compound.

Series of Isomeric Derivatives from Toluol.—MM. Beilstein and Kuhlberg.—Paranitrotoluidin, $p.C_7H_6(NO_2)(NH_2)$, is prepared by the reduction of dinitrotoluol and hydrosulphide of ammonium; it exhibits a yellow-coloured crystalline mass, fuses at 77°, is soluble in hot, not so well in cold, water; the nitrate, hydrochlorate, and sulphate of this base are all crystalline substances. Nitrate of paradiazo-nitrotoluol, $p.C_7H_6(NO_2)N_2.NO_3$, is obtained by treating nitrate of para-nitrotoluidin with nitrous acid. Of the long series of derivatives obtained, we only mention yet β nitrotoluol. $\beta C_7H_7(NO_2)$ is a liquid boiling at 222°C., having, at 25°C., a specific grauity of 1·163; is not acted upon by chromic acid.

Observations concerning the Essay of Fremy on Hydraulic Cement.—M. A. Schulatschenko.—The only matter of interest to our readers in this paper (which reviews all which has been stated and done from the year 1786, beginning with the celebrated Chaptal, up to the present day, as regards the hydraulic and other cements, especially in respect to the cause of the hardening under water as well as in air), is the analysis of a marl found on the borders of the river Wolchow, Russia, and applied to the manufacture of cement by careful burning. In 100 parts, this material contains—Carbonate of lime, 63·84; carbonate of magnesia, 5·78; peroxide of iron and alumina, 3·22; sulphate of lime, 0·32; water, 1·04; the remainder was insoluble in hydrochloric acid, and consisted of—Silica, 18·16; alumina, 2·02; peroxide of iron, 3·56; potassa and soda, 1·66; together, 99·60. This material yields, after burning, a product which, on being treated with water, becomes strongly heated, swells up and falls to powder, as does burnt limestone, but unlike it, the material alluded to hardens slowly under water; if, however, this marl happens to be more strongly burnt, exposed to more than a faint red heat, not visible in daytime, a product is obtained which does not, on coming into contact with water, act as just described, but which very rapidly sets and hardens under water. The author observes that we have to distinguish two kinds of cement—such as contain lime in a free state, the Roman cements of M. Winkler, and the hardening of which has been fully explained by Fuchs, and such cements as do not contain lime in a free state, the Portland cements of M. Winkler, the hardening of which is as yet not well explained. According to M. Rivot and others, the cause of the hardening is due to the binding of water by the silicates formed during the burning, while, according to Winkler and others, the effect of water and the cause of hardening is due to the splitting up of silicates into more simple silicates. It is a fact, however, that the action of lime upon Puzzolanes is not sufficiently great solely to explain the hardening of cements.

No. 10, June 8, 1869.

We learn from this number that a very flourishing Chemical Society has, with the permission of the Imperial Government, been established and recognised as one of the scientific institutions of the Russian Empire; the transactions of this society are to be published in the Russian language. The only original paper in the above-named periodi-

cal is the record of several researches made at St. Petersburg—

Isomeric Phenolsulpho-Acids, and the Action of Chloride of Benzoyl on the Potassa Salt of that Acid.—M. Solomanoff.—according to the author's researches, there exist three isomeric phenolsulpho-acids, all of which are simultaneously formed when sulphuric acid acts on phenol. The author distinguishes these acids by α, β, and γ, or by prefixing to the two first para and meta; the author prepared these acids in rather large quantities; the potassa salts of these acids are distinguished from each other by the following particulars: the α salt, $C_6H_5KSO_4$, crystallises in six-sided foliated crystals, is the most difficultly soluble of the three salts in water, fuses at 240° C.; the β salt crystallises in needle-shaped crystals, and is capable of taking up variable quantities of water of crystallisation, varying from 1·01 per cent to nearly 15 per cent; it fuses at between 235° and 240° C., yielding a yellowish liquid; the γ salt contains from 16·28 to 17·51 per cent of water of crystallisation, does not, on being heated, melt until it just reaches 240° C. When α phenolsulpho-potassium is heated with chloride of benzoyl, hydrochloric acid is given off and benzoyl-phenolsulpho-potassium is obtained; this salt is soluble in water, and crystallises from its solutions therein in large needle-shaped crystals; the corresponding γ compound, after having been dried at 130° C., is composed according to the formula $C_6H_4(KSO_3)O(C_7H_5O)$; it is difficultly soluble in cold water, but readily in hot water; also soluble in warm alcohol.

Action of Chlorosulpho-Anhydride, $HClSO_3$, on Phenol and Phenolsulpho-Potassium.—MM. Engelhardt and Latschinoff.—The authors made some experiments in order to ascertain whether, when instead of sulphuric acid the compound SO_3HCl was made to act upon phenol, the result would be the formation of one acid only, or of three isomeric acids, as in the instance just previously alluded to; when to one equivalent of phenol, one equivalent of SO_3HCl is added, a very strong reaction takes place, the mixture becomes hot, hydrochloric acid is given off, a thickish red-coloured mass is obtained, from which, by gently heating, all hydrochloric acid was expelled; the mixture after having been formed into a potassium salt, this proved on analysis to be pure α or para phenolsulpho-potassium; the authors made experiments with divers proportions and quantities of SO_3HCl and phenol, and found as result chiefly the production of the acid of the salt just referred to.

Phenol Phosphosulpho-Acid.—M. Maikopar.—The author has studied the action of sulphuric anhydride upon phosphate of phenol, and also the action of phosphor oxychloride upon para phenolsulpho potassium; the author describes at great length his researches; dry phenol phosphosulpho-barium, $(C_6H_4BaSO_3)_3PO_4$, gave in 100 parts—Baryta, 27·72; sulphuric acid, 29·84; and phosphorus, 4·03. When oxychloride of phosphorus was heated with dry para phenolsulpho-potassium a solid mass was obtained; on exhausting this with ether the latter left on evaporation an oil which was found to contain chlorine, phosphorus, and a substance belonging to the phenolsulpho-acid group; but the results of the analysis of this substance gave figures from which no definite formula could be deduced.

On Murrayin, a Newly-Discovered Glucoside.—Prof. Blas.—The author states that he received from Dr. de Vrij a quantity of murrayin, extracted by the latter gentleman from the *murraya exotica* during his sojourn in the East Indies; in pure state murrayin is a white coloured solid substance, exhibiting needle-shaped crystals, its taste is slightly bitter; it is difficultly soluble in cold water, and insoluble in ether, readily soluble in boiling water and in alcohol; these solutions are neutral to test paper. Murrayin fuses at 170°C.; is readily soluble in solutions of caustic and carbonated alkalies; these solutions exhibit a high degree of fluorescence, they appear yellow in direct light, greenish blue when the rays of sunlight are made to pass through the solutions; crystallised murrayin has the formula $C_{26}H_{44}O_{20}+H_2O$; when one part of murrayin is mixed with one part of strong sulphuric acid, and 25 parts of water, and this mixture heated in a sealed tube or in a flask, in an atmosphere of carbonic acid, the substance is split up, murrayetin and sugar being formed; this splitting up takes place according to the following formula:—

$$C_{26}H_{44}O_{20}+2H_2O=\underbrace{C_{24}H_{24}O_{10}}_{\text{Murrayetin.}}+2C_6H_{12}O_6.$$

Murrayetin is a solid substance, which readily crystallises its concentrated solutions have a weak acid reaction; with perchloride of iron, it yields a beautiful blue colouration.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 1, July 5, 1869.

A very considerable portion of this number is filled with a lengthy discussion on some ancient letters and papers of historical interest. Incidentally with this subject, M. Balard stated that, having made use of M. Carré's plan to immerse written papers in dilute hydrochloric acid (one part, by bulk, of acid, to ten parts of pure water), he found very old writing to resist, even for fully twenty-four hours, the action of this acid, and that, although the figures become rather yellowish, they were perfectly and distinctly legible; yet, though this holds good for the documents operated upon, which were written between the years 1577 and 1770, it does not for documents tested in the same manner and written between the year 1793 and 1867. The observation was made that some ancient writing turned red in the acid; and, since this indicated the use of logwood in the ink, it was doubted whether this material had ever been applied at so remote a date as even the end of last century for ink making. M. Balard stated that he had found, in books printed and published more than 100 years ago, prescriptions to make black writing ink with logwood. M. Chevreul asked M. Balard whether he had tested the inks for oxide of manganese, since some prescriptions for the manufacture of black writing ink advise the addition of a salt of the protoxide of this metal, in order thereby to have a means of detecting any attempt to destroy the writing by means of chlorine. M. Chevreul pointed out the great difficulties in testing, by such methods, any writing, owing to the composition of the ink, the kind of paper, whereon is written, its sizing, and the very varying conditions wherein written documents may have been kept.

Researches on the Galvanic Battery, and the Origin of the Heat which is Produced in the Elements and is not Transmissible to the Conducting Wires.—M. Favre.—This is another portion of a lengthy memoir on this subject, and is full of a series of tabulated results, which cannot be left out without impairing the value of the research; we therefore only quote the title.

Poisonous Properties of Coralline, as used for Dyeing Purposes.—M. Tardieu.—This author, although not wishing directly to contradict M. Laudrin, insists upon the fact that silk stockings, dyed with coralline, and absolutely free from any such substances as arsenic, mercury, or lead, cause, to those who wear these on their feet, in many instances, grave inconvenience, certainly not due to the silk, and thus, inferentially, due to the dye.

Heat of Transformation of some Isomeric Bodies.—MM. Troost and Hautefeuille.—This memoir, a physico-chemical essay, treats of—1st, the heat of transformation of cyanic acid into cyamelide; 2nd, the heat of transformation of cyamelide into cyanuric acid; 3rd, on the relation which exists between the heat given off by the combustion of a substance and its specific gravity (under this head, sulphur and arsenious acid are treated).

Relations which Exist between Amido Acids, derived from Benzoic Acid, and the Alkaloids derived from Toluen.—M. Rosenstiehl.—The author says, there exist three acids, the composition of which is

expressed by the formula $C_7H_5(NH_2)O_2$; they are—the *amido-benzoic, amido-dracylic*, and *anthranilic acids;* we are acquainted, moreover, with only two homologous alkaloids—to wit, *toluidine* and *pseudo-toluidine*. In order to elucidate the question, What relation there exists between these acids and the alkaloids, the author has acted upon these acids with hydriodic acid at a temperature of from 180° to 200°. The amido-benzoic acid yields pure toluidine, without any secondary product; amidodracylic acid yields pseudo-toluidine, but a secondary reaction takes place simultaneously, whereby, carbonic acid, aniline, and hydride of methyl are formed; anthranilic acid behaves as amidodracylic acid.

Solubility of Sulphur in Coal-Tar Oils.—M. Pelouze.—The author has operated with light benzines, sp. gr. 0·870 to 0·880, the former boiling between 80° and 100°, the latter between 85° and 120°; heavier benzines, sp. gr. 0·882 to 0·885, the former boiling at from 120° to 200°, the latter at from 150° to 200°; heavy oils, sp. gr. 1·010 to 1·020, the former boiling at from 210° to 300°, the latter at from 220° to 300°. The temperatures at which the solvent action upon sulphur was tried with these divers liquids, varied from 15° to 130°. The light benzines dissolve in the range of temperature up to their boiling point, from 2·5 per cent to 27 per cent of sulphur; the heavy benzines dissolve, for the same range of temperature, from 2·5 per cent to 38·7 per cent of sulphur; while the heavy oils dissolve in a range of temperature, from 15° to 110°, from 6 to 115 per cent of sulphur, and above 110° to 130°, indefinite quantities of that metalloid. At temperatures ranging from 200° to 300°, sulphur decomposes the heavy oils, sulphuretted hydrogen being set free.

Les Mondes, June 17, 1869.

We notice from this paper, in the first place, the few, but interesting words written by the Rev. Father Secchi, S.J., to M. F. Mazco, at Turin—

On Electricity.—"I believe that the true theory of electricity will result from the principle that electricity is not a motion (*mouvement*), but a change of the quantitative and dynamic equilibrium of the ether which constitutes the atoms of the substances, and that the propagation of such a change is brought about by the moving of the ether from one atom to another; this motion shakes, disturbs the ether of the atoms, and thus produces heat."

Balances of Great Precision.—It appears that the celebrated physical instrument makers, Collot Frères, Paris, have greatly improved the mode of making balances, by devising what is called a balance on two columns. Without reproducing the woodcut contained in the above-named periodical, it is not easy to describe this instrument so as to be clearly understood by our readers; the system is an entirely new one, and by its application only is it possible to place the point of support on the axis of the balance, and thereby to shorten the length of the arms which bear the weight. Among the particulars mentioned of balances made according to this new system, we quote a balance made to bear, in each pan, 35 kilos., and sensitive with that load for 5 milligrms., and possessing, at the same time, perfect stability. Several balances of this kind have been made for the Russian Government; and the University of Upsala, Sweden, has two balances, each to carry 1 kilo. in each pan, and sensitive for 1½ milligrm. The laboratory of the School of Mines, Paris, has received, from MM. Collot, a balance of precision which, the author says, excels anything hitherto made. Balances with aluminium beams have also been introduced by these makers.

Among the acknowledgments of books received, we notice brief reviews of two small pamphlets, written and published in Italian, by the Rev. Father Secchi, S.J. The first of these books is entitled "*The Prismatic Spectra of the Heavenly Bodies.*" Contents—1st, the prismatic spectra of the fixed stars; 2nd, the catalogue of the stars of which the luminous spectrum has been determined; 3rd, description of the instruments applied in this investigation. The work is illustrated with beautifully-executed engravings, and is, according to the opinion of the reviewer in *Les Mondes*, an almost herculean labour, executed with a care and precision which might, at first sight, appear to be beyond the powers of one man. The other work is on "*The Nebula of Orion*," and is rather an astronomical essay.

Researches on the Propagation of Sulphuretted Hydrogen Gas through other Gases.—Dr. Hillebrandson.—The author of this memoir, originally published in Swedish, has made a series of experiments with sulphuretted hydrogen gas, because it is very readily detected, and its presence shown among other gases; these experiments fully confirm what is already well known on this subject.

June 24, 1869.

This number contains more information on the subject of the—

Oxyhydrogen Illumination.—L'Abbé Moigno.—This paper is written with the express view of meeting the objections made in public prints against this mode of procuring artificial light, and answers each objection completely. The first objection, made and refuted, concerns the alleged difficulty which oxygen is supposed to have, of passing readily through pipes, and travelling therein with ease, on account of its high specific gravity; the author states that experience has proved that, under the same, and, in all respects, identical conditions, oxygen gas travels more rapidly than hydrogen. Another point is an objection concerning the comparative rare occurrence of peroxide of manganese, and the difficulty of obtaining it; to this the reply is, there is plenty of manganese, of excellent quality, readily accessible, and more than fifty times as much as any greatly-increased demand will ever absorb; moreover, the oxygen is made from permanganate of soda, which, it appears, is revived again after having yielded its oxygen. One ton of this permanganate yields in twenty-four hours 100 cubic metres of oxygen; and, from reliable data obtained, 300 tons of the salt will suffice to produce yearly about 10,000,000 cubic metres of oxygen gas (a cubic metre is equal to 35·316 cubic feet). These 300 tons of permanganate are composed of 150 tons of soda, and 150 tons of peroxide of mangnese, an insignificantly small quantity, compared with the 60,000 tons which are consumed of this material annually. As to the too slow production of oxygen, the author says, at the oxygen gas-work, when in regular course of working, they have obtained, from each retort, 38 cubic metres of pure gas per day; as to the cost, he states that the gas-work intended to be established will cost, everything included (retorts, &c., gas-holders to hold 24,000 cubic metres of gas for twenty-four hours' supply, 32 kilometres' length of mains), 3,700,000 francs; as to the objection concerning the zirconia, or magnesia cones, these last for several days, and only cost one centime; at the same time, the glass chimneys and globes are dispensed with. As to the expense of this gas, it appears, from the statements of the author, that, taking into consideration the great quantity of light obtained, it is decidedly less expensive. The manufacture of hydrogen, by means of the patented process, from hydrate of lime, is, according to the author, very simple, and the pure hydrogen thus obtained costs less than two centimes per cubic metre, leaving even out of the question the sale of the by-products, which would not be trifling. Lastly, the author tells us that MM. J. Dumas (Senateur, &c.), Jamin, Balard, and H. Sainte-Claire Deville, all Members of the Institut; M. Debray, of the French Imperial Mint; and M. Alphand, Director of Public Rords and Promenades, have been appointed a committee, by M. Haussmann, Préfet du Département de la Seine, to inquire into, and minutely report upon, this subject in all its aspects and details.

July 1, 1869.

We learn from this number that M. Wurtz, of Paris, has been on an inspection journey to Germany, by order of the Minister of Public Instruction, to report upon the chemical laboratories of Germany, and to give his opinion as to the

progress of chemistry made in that country. The lengthy report of the eminent Doyen de la Faculté de Médicine of Paris may be summed up in these few words—That the material aid given to chemistry in Germany has developed that science there to a degree which it lacks in France, as well as in most other countries. It is not for want of zeal and industry, says the eminent *savant*, but for want of the material aid—good laboratories, plentifully supplied with all requisites—that we are behind, as compared with Germany.

Cyanide of Potassium in Blast Furnaces.—M. H. Pagot has made a series of experiments, on the large scale, at the blast furnaces of Randonnay, Département de l'Orne, and found that the fact announced now many years ago, by Messrs. Lyon Playfair and Bunsen, of the presence of cyanide of potassium in blast furnaces, is a reality, and that the salt is formed there in such large quantities that it might easily become a useful and plentiful by-product of ironworks.

Extension of Sulphuric Acid Manufacture.—M. Perret.—The enormous pyrites deposits of Chessy and St. Bel, France, are advantageously applied, by the owner of that mineral deposit, to manufacture, at five different sulphuric acid works, a quantity of no less than 100 tons of concentrated acid daily, exclusive of the simultaneous manufacture of a great many other chemicals, in the preparation of which sulphuric acid is used. The pyrites alluded to contains a sufficient amount of copper to make the extraction of that metal from the burnt pyrites a paying business. This mineral is largely exported from France into those places where it can be taken to at a remunerative price; the locality where the mineral is found is too far away from the sea or any readily navigable river thither to admit of its exportation being extended beyond the limits of localities on and near the Franco-Swiss and Italian frontiers.

The Journal of the Franklin Institute, May, 1869.

Among the Editorial Items and Novelties we meet with the following original communications:—

Invisible Light.—Prof. O. A Rood.—Many years since, the author says, a photograph was made, at Berlin, of the well-known bronze statue of the Amazon; and it was observed that, in the negative, a black streak occurred at the tip of the lance (held by the figure in an almost vertical position) while two other analogous marks appeared in other locations. This picture was sent to Prof. Dove (Berlin), whose investigations in connection with light are widely known, and he came to the conclusion that these markings might be due to electrical discharges going on from prominent points of the figure at the time the picture was taken, and which, though invisible to an observer, would, nevertheless, by reason of the high actinic power of electric light, produce an impression on the photographic plate. This conjecture has been fully confirmed by the author, who, in a series of ingenious experiments, proved that electric discharges, entirely invisible to the observer in the presence of daylight, might, nevertheless, produce images of themselves in a picture of the adjacent objects taken at the same time, the photographic plate being relatively more sensitive to these impressions than the human eye. The author describes at length his mode of experimenting; but, without a reproduction of the woodcuts illustrating this paper, it is not possible to enter into more details on this subject.

New Arrangement of the Holtz Machine.—Prof. Smith.—In the ordinary mode of excitation of the Holtz machine, the knobs of the dischargers are placed in contact, and afterwards separated; the excitation cannot be produced without contact. It follows, that, when the balls are separated beyond the striking distance, all action will suddenly cease, and, to renew it, the balls must again be brought together; and frequently, in addition to this, a new excitation of the sectors will be required. A large class of electrical experiments require, virtually, this separation of the balls beyond the striking distance—*e.g.*, the "electrical flyers," the "head of hair," and the insulating stool. The author fully explains his arrangement, so as to keep up an unlimited excitation, whatever be the number of points applied to the prime conductor, or whatever may be the distance of the balls of the dischargers; and, in order to excite the machine, it is not necessary that the balls should be in contact. We cannot, without woodcuts, give more details from this paper.

The greater part of the remaining papers of this number treat on matters of engineering, or are reproductions from papers found in European periodicals, among which the Chemical News occupies a prominent place.

Moniteur Scientifique, No. 300, June 15, 1869.

The greater part of this periodical is occupied with translations of papers taken from English and German periodicals already noticed by us. Among the original papers relating to natural sciences, excluding physiology, medicine, and natural history, we meet with a paper—

On the Rotatory Equivalent of Cane Sugar and Rock Crystal in their bearing upon Optical Saccharimetry.—M. Dubrunfaut.—The author states that the figure, 16·471 grms., which in the year 1850 was adopted as the correct unit for optico-saccharimetrical experiments, is wrong, and has been afterwards altered to 16·350 grms.; he next adduces, as proof of the necessity of a revision, also, of that last figure, some experiments of his, recently made with samples of sugar kept as standards at the French Ministry of Commerce. The author further alludes to the impurities of refined sugar as the cause of these errors, and finally states that, when a really well-made optical saccharimeter is used, and pure sugar, the figure 15·976 grms. represents truly the absolute rotatory equivalent of rock crystal as well as of pure cane sugar. The author quotes the results of an analysis of refined sugar, purified by him, by means of pure absolute alcohol, as follows, in 100 parts:—Ash, 0·00039; water, 0·00030; glucose, 0·00018; and traces of lactic acid. It appears, however, that M. Dubrunfaut is entirely unacquainted with the extensive series of experiments made on this subject in the Netherlands by Profs. G. J. Mulder, P. Harting, and F. C. Donders, and at Breslau by Dr. Duflos and M. Schloesser.

Among the subjects of *brévets d'invention*, we notice—

A Process of Preserving the Yolk of Eggs, patented by M. D'Andiran-Kœchlin, consisting in adding to the previously-broken-up yolks of eggs (the white being entirely separated and applied for the purposes of calico printing), after having been dried, from 3 to 5 per cent of common salt, and one part per 1000 of arsenious acid. This yolk is not intended for food, but for the glove and wash-leather making factories; it is kept in air-tight vessels, filled without leaving any air whatever inside, and a couple of drops of pure carbolic acid are added to every litre of this homogeneous fluid.

To three gentlemen, has been granted a *brévet* for—

The Extraction of Benzine and its Homologues from Illuminating Gas obtained from Coals.—The precise process is not described; but, although it is certainly true that illuminating gas contains, by weight, ten times as large a quantity of benzine as does the coal-tar obtained at the same time, it is equally true that this benzine cannot be withdrawn from gas intended to serve the purposes of yielding good artificial light without greatly injuring its qualities in that aspect.

Improved mode of Manufacturing Glucose from Starch.—M. Maubré.—The author states that, by the usual mode of proceeding, a portion of the starch is always left in the state of dextrine; he therefore operates under pressure and a higher temperature. For this purpose, he applies a strong cylindrically-shaped iron vessel, internally lined with lead: this boiler is charged with 28 kilos. of sulphuric at 60° Beaumé, and 2800 litres of water, and th

brought to the boiling point by means of high pressure steam. When boiling, there is gradually run into this fluid a mixture of 1180 kilos. of starch and 2500 litres of water, acidulated with 28 kilos. of sulphuric acid. When the whole of this quantity has been introduced into the aforesaid boiler, it is closed, and the temperature within it raised to 160°, by means of high pressure steam introduced into the boiler by leaden and perforated pipes. After about four hours, the action is complete, the fluid run off into tubs, and the acid saturated by means of 84 kilos. of finely-powdered good limestone. After separation of the sulphate of lime, the fluid is evaporated to 20° B., clarified with animal charcoal, and next evaporated in vacuum pans, yielding an excellent and beautiful glucose.

No. 301, July 1, 1869.

The only original paper contained in this number, is on the—

Platinizing of Looking-Glasses.—M. Jouglet.—This paper, a very verbose and lengthy dissertation on a comparatively-speaking very trivial subject, appears to have been written with the view to bring forward a peculiar kind of manufacturing process, which, if it is attended with any improvement at all, will receive, no doubt, full justice at the hands of the public, who may be trusted to distinguish whether the covering the back of plate-glass with a thin layer of platinum is an advantage over the silvering, or amalgamating, generally applied for this purpose. The process itself does not seem to contain any novelty, and is described in this paper in a tediously-puffing style.

Cosmos, July 3, 1869.

New Dye from Madder.—Prof. Rochleder, at Prague, has found that, when madder is treated with dilute mineral acids, it yields, beside alizarine and purpurine, a small quantity of a third tinctorial substance, which, in alkaline solution, has a great similarity to chrysophanic acid dissolved in alkaline solution; acids precipitate it from this solution in the amorphous flocculent shape, the precipitate being of a pale yellow colour. This substance is soluble in alcohol and in acetic acid, and crystallises from these solutions, on the evaporation of the solvent, yielding orange-yellow coloured crystals; its aqueous solution mixed with acetic acid, and brought to boiling point, imparts to silk and wool immersed in that bath a beautiful and durable golden-yellow colour.

July, 10, 1869.

This paper contains, as usual, a variety of information. The only note suitable for our readers is—

On the Seat of the Hygroscopic Properties of Silk.—M. Suida.—It is a well-known fact that crude silk is very hygroscopic; and some doubt has existed as to whether the exterior gum-like varnish of the raw silk, or the interior fibroine, was the chief seat of this great avidity for moisture. The author has taken a certain quantity of one and the same kind of silk (the avidity for moisture is by no means the same for all silks the produce even of one and the same country, and therefore it was necessary to operate upon one sample of known and the same origin), a portion of which had been deprived of its natural gum, while another portion was in its native state. The results of very carefully instituted experiments is, that the fibroine—that is to say, the essential fibre of the silk itself, and not its tegumentary parts, gum chiefly, are the seat of the hygroscopic properties of raw non-dyed silk; the process of dyeing materially altering the fibre, also affects its hygroscopic properties. In 100 parts of silk, according to Mulder's analysis, the only extant, this substance consists of:—Fibroine, 53·37; gelatine, 20·66; albumen, 24·43; wax, 1·39; yellow colouring matter, 0·05; resinous and fatty matters, 0·10; this analysis refers to yellow (naturally coloured) silk from Naples. White native silk from the Levant was composed, in 100 parts, of—Fibroine, 54·04; gelatine, 19·08; albumen, 25·47; wax, 1·11; resinous and fatty matters, 0·30.

Bulletin de la Société Chimique de Paris, June, 1869.

From the *procès verbal* of the meeting of this society, held on the 16th of April last, we quote the following:—

M. Lefranc, a pharmaceutical chemist of the French army, presented to the Society a printed pamphlet—

On Atractylic Acid and Atractylates.—This acid is a naturally-existing compound sulpho-acid, met with in the *Atractylis gummifera* as a potassa salt; it is split up, by the action of acids, into sulphuric and valerianic acids, glucose, and a resin.

M. Tollens stated at the meeting that the well-known reaction of hypochlorite of lime and aniline is interfered with by the presence of ammonia, or any salt thereof, and that then the reaction only takes place when a large excess of chloride of lime is applied.

The following original papers are published in this number:—

Action of the Electric Spark upon Marsh Gas.

Direct Union of Free Nitrogen and Acetylene, and the Direct Formation of Hydrocyanic Acid.

Both these papers having been read by the author, M. Berthelot, also at meetings of the Académie des Sciences, have been already noticed by us; this remark equally applies to the next paper, by the same author—

Formation and Decomposition of Sulphide of Carbon.

Chemical Equilibrium, and the Influence of Pressure as Affecting the Action of Carbon and Hydrogen upon each other.—M. Berthelot.—The chief result arrived at by the author is that, when the pressure varies continuously, the equilibrium between carbon and hydrogen changes by sudden shocks, thereby following rapports which are the multiples of the one and the other.

Essence of Sassafras.—Messrs. Grimaux and Ruotte.—The essential oil of sassafras, obtained from the *Laurus sassafras*, is, when recently rectified, a colourless fluid, which, at 0° C. (32° F.), has a specific gravity of 1·0815. The oil is a mixture of a hydrocarbon and an inactive oxygen-containing principle; this latter consists, in 100 parts, of—Carbon, 74·43; hydrogen, 6·46; oxygen, 19·11. It is present in the natural oil in so small quantity that only just sufficient for a good elementary organic analysis was obtained. The hydrocarbon (safren) contains $C_{10}H_8$, and consists, in 100 parts, of—C, 88·23; H, 11·77. Its vapour density has been found equal to 4·84. Safren boils at about 156°. The oil further contains safrol, $C_{10}H_{10}O_2$, boiling at between 231° and 233°. Safrol is insoluble in water. Its specific gravity is 1·1141 at 0°; at −20° it is not frozen. The authors have studied the action of bromine, of hydriodic acid, of perchloride of phosphorus, and nitric acid upon safrol, but state that none of these reactions gave such results as they expected. With bromine, safrol yields a compound of the formula $C_{10}H_8Br_2O_2$.

Presence in the Air of Active Oxygen, or Ozone.—M. Houzeau.—The author demonstrates, at great length, in this paper that the air of the country is of a different character from that of towns; that the former is strongly disinfectant, has far greater bleaching power, and, especially after rainfall, affects bright and oxidisable metals far more than is the case in towns. This paper is not intended as a fully-demonstrative memoir, but in it the author calls attention to some facts readily observed, as, for instance, the rapid bleaching of all kinds of woven fabrics, be they made of linen, cotton, or woollen fibre; the rapid fading of very many dyed tissues; the far more active rusting of iron, steel, and even copper, in the country as compared with large towns. Curiously enough, the author does not mention the well-known fact of the effects of the air at sea, even at comparatively short distances from the shore, nor, also, the peculiar effects produced by the mountain air at no greater height than from 2000 to 6000 feet above sea-level.

Bromide and Iodide of Propionyl.—M. Sestini.—The specific gravity of the bromide of propionyl is, at 14°, equal to 1·465; its boiling point is about 97°; water decom-

poses it; formula, C_2H_5OBr. The iodide of propionyl boils at 127°; its specific gravity is far greater than that of water, in contact with which it is decomposed instantaneously; formula, C_3H_5OI.

Soluble Albumen which is not Coagulated by Heat.—Dr. Monnier.—We have already noticed this communication, but have to rectify the name of the author's place of residence, which is not *Lyons*, but *Nyon* (a town in the Département de Drôme); the *Deutsche Industrie Zeitung*, from which our abstract was made, had printed *Lyons*.

Use of Phosphate of Soda for Removing Manganese out of Solutions wherein Zinc has to be Estimated Volumetrically.—M. Renard.—The author states that he dissolved 1 grm. of zinc in hydrochloric acid, added thereto 0·6 grm. of chloride of manganese; next ammonia was added, and after that phosphate of soda; the result of his volumetrical estimation of zinc in this solution came to 0·998 grm. of zinc. When the addition of phosphate of soda to a solution of precisely the same composition as the one alluded to was omitted, the quantity of zinc was found to amount to 1·036 grm. The ferrocyanide of potassium process was used in these experiments.

The remaining pages of this periodical are filled with abstracts and translations from English, German, and American periodicals, and with abstracts from the *Comptes Rendus*. The large majority of these are taken from works published during the course of last year; most of them have been already noticed by us.

Journal für Praktische Chemie, No. 6, 1869.

This periodical opens with a very lengthy and exhaustive essay on the

Affinity between Solution of Acetate of Iron without Change of State of Aggregation.—Prof. A. Müller.—This memoir is subdivided into several chapters, and has a series of tabulated forms added: it is not well suited for abstraction.

Chemical Researches of the Eozoon Stone at Raspenau, in Bohemia.—Dr. R. Hofmann.—The stone here alluded to appears to be a serpentinoid mineral, embodied in a kind of dolomite, of which the composition, in 100 parts, is as follows:—Carbonate of lime, 58·815; carbonate of magnesia, 40·20; peroxide of iron, 4·291; insoluble in HCl, 1·261; water, 0·083; traces only of phosphoric acid. The shell of the eozoon stone consists, in 100 parts, of—Carbonate of lime, 97·711; carbonate of protoxide of iron, 1·660; carbonate of magnesia, a trace; alumina, 0·629; minute traces of phosphoric acid. The central portion of the inner part of the eozoon stone has a specific gravity of 2·687, and consists, in 100 parts, of—Water, 7·092; silica, 36·425; alumina, 32·944; protoxide of iron, 20·140; lime, 0·678; potassa, 2·721.

Dolomitic Limestone of Cheynov, near Tabor, in Bohemia.—Dr. R. Hofmann.—This limestone is deposited among and embedded in gneiss; it varies in composition as well as in specific gravity, the latter having been found as low as 2·711, and as high as 2·861; its extremes of composition, in 100 parts, are as follows:—Carbonate of lime, 98·418, and 57·809; carbonate of magnesia, 0·009, and 39·186; protoxide of iron, 0·346, and 0·628; peroxide of iron and alumina, none in either sample; insoluble in hydrochloric acid, 1·167, and 2·377.

Composition of Hauyn.—Prof. A. Kenngott.—This is a purely mineralogical paper.

Basic Salts of Zinc and Copper.—M. Franz Reindel.—The author says that, when a boiling solution of sulphate of zinc containing an excess of that salt is treated either with a solution of caustic or carbonated alkalies, precipitates are formed which, both in consequence of their comp[illegible] and of their peculiar behaviour towards re[illegible] the attention of chemists. It has often [illegible] pure $CuOCO_2$ may be obtained by decomp[illegible] of $CuOSO_3$ with 1 equivalent of $NaOCO_2$. The author has digested the mixture obtained as result of this reaction for one month with a concentrated solution of soda in the cold, and has not been able thus to obtain, even after very careful washing out, a product entirely free from sulphuric acid. The basic sulphate of zinc obtained by boiling a solution of sulphate of zinc in excess with ammonia constitutes a white powder, which, on being washed with water, is steadily but very slowly decomposed; the fluid running off from the filter has an acid reaction, and contains sulphuric acid as well as oxide of zinc. The author gives, in this lengthy and still unfinished paper, several analyses of basic salts, obtained under a variety of conditions, and dried at temperatures varying from 110° to 260°, whereby the quantity of water of these salts is reduced, but not eliminated, for some of these salts lose water up to a red heat.

Influence of Water upon some Siliceous Minerals.—M. A. Cossa.—The minerals submitted to experiment were two kinds of gneiss, syenite, several kinds of trachyte, granite, and basalt. They were reduced to powder, and left for ten days in contact with twenty-five times their bulk of pure water, at a temperature of from 17° to 18°, the filtrates were evaporated to dryness, and, after having been moistened with hydrochloric acid, again evaporated, and the dry residue weighed as chlorides. The weight of these residues varied from 0·0567 per cent to 0·35 per cent of matter dissolved.

Annales de Chimie et de Physique, April, May, and June, 1869.

We do not separately notice each of them, for the reason that the last essay which concludes the number for May is continued through that of June, but not yet concluded.

The April number of this periodical opens with a portion of M. Friedel's essay on the **Acetons and Aldehydes**, which is concluded. Next we meet with a biographical notice of M. Sadi Carnot, by Le Comte Paul de Saint Robert. Next follows—

Researches on Resins.—M. Sace.—The author observes that resins have been very little studied at all; and his researches recorded in this paper extend to copal, amber, dammar, colophony, lac (or shellac), elemi, sandarac, mastic, and carnauba wax (a resin). The author has studied the more or less degree of readiness wherewith resins are reduced to powder, the action thereupon of boiling water, of alcohol of 86 per cent strength, of ether, of ordinary acetic acid, of a hot solution of caustic soda of 1·074 specific gravity, of sulphide of carbon, of oil of turpentine, of boiled linseed oil, of benzine, of naphtha, of sulphuric acid of 1·83 specific gravity, of nitric acid of 1·329 specific gravity, and of caustic ammonia. All resins were applied in powdered state; and the solvents three times as large a bulk as that of the resins have acted for at least twenty-four hours, at temperatures varying between 15° and 22°. The general results arrived at are briefly as follows:—All resins submitted to experiments fuse quietly when heated, excepting amber, shellac, elemi, sandarac, and mastic, which swell up, and increase in bulk. Only the carnauba wax melts in boiling water; colophony becomes pasty therein, while dammar, shellac, elemi, and mastic agglutinate. Copal, amber, and sandarac do not change. Alcohol does not dissolve amber nor dammar; agglutinates copal, partly dissolves elemi and carnauba wax; while colophony, shellac, sandarac, and mastic are readily soluble therein. Ether does not dissolve amber and shellac; makes copal swell, and partly but slowly dissolves carnauba wax; dammar, colophony, elemi, sandarac, and mastic are readily dissolved therein. Acetic acid does not dissolve amber and shellac; causes copal to swell; somewhat acts upon carnauba wax, [illegible]ell act upon any other of the resins above [illegible]ly dissolves shellac, [illegible]pon the rest. In [illegible]soluble; copal

swells therein; elemi, sandarac, mastic, and carnauba wax are difficultly dissolved therein, while dammar and colophony are readily so. Oil of turpentine has no action upon amber or shellac; causes copal to swell up; dissolves readily dammar, colophony, elemi, sandarac, carnauba, and very readily mastic. Sulphuric acid does not dissolve carnauba wax; all other resins are dissolved and coloured brown, excepting dammar, which becomes bright red. Nitric acid does not act upon the resins, but colours carnauba wax straw-yellow, elemi a dirty yellow, and mastic and sandarac bright brown. Ammonia does not dissolve some of these resins, but causes copal, sandarac, and mastic first to swell, afterwards dissolving them; colophony is easily soluble therein.

Researches on the Composition and Structure of Meteorites.—M. S. Meunier.—A very interesting and elaborate essay on this subject, but too long for proper abstraction.

On a Pump provided with a Free Plunger (*pompe à piston libre*).—M. le Marquis de Montrichard.—A physico-mechanical paper.

Pyro-Electric Properties of Crystals which are Good Conductors of Electricity.—M. C. Friedel.—The abstraction of this paper, without the re-production of the large number of woodcuts essentially belonging thereto, would be useless.

Nitrites of the Fatty Acids.—M. A. Gautier.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, April, 1869.

We notice the following original papers:—

On Cytisin, an Alkaloid of the Genus Cytisis.—Dr. A. Husemann.—The seed, bark, and root of the well-known laburnum tree (originally from Switzerland, but now dispersed throughout Europe), *Cytisus laburnum*, L., contains, it appears, an alkaloid, which has been isolated by the author, and is described by him as a white crystalline solid substance, of bitter and somewhat caustic taste, soluble in water and alcohol, and hardly soluble at all in ether, chloroform, benzol, and sulphide of carbon. Cytisin is a strong basic substance, precipitating many metallic combinations from their solutions, and setting free ammonia from its compounds. Its composition, in 100 parts, is:—C, 73·84; H, 8·30; N, 12·92; O, 4·94; formula, $C_{20}H_{27}N_3O$. The nitrate of cytisin is a readily-crystallisable salt.

The other original paper is one belonging strictly to botany. Among the miscellaneous papers met with in this periodical, we meet with a communication—

On the Varieties of Taploca and Sago Prepared in the Malaccas.—It appears that, at the request of the resident Governor of the Malacca Islands, researches have been instituted concerning this food, at the Laboratory, at Welte Vreden, Java. The authors of this paper, MM. Maier, Moens, and Scharlec, found that three varieties of sago, denominated white, red, and blue, contain, respectively—water, 16·14, 18·83, and 18·47 per cent; protein compounds, respectively—3·7, 2·5, and 2·4 per cent; starch, fat, &c., respectively—79·88, 78·06, and 78·15 per cent; ash, respectively—0·22, 0·52, and 0·94 per cent.

The remainder of the miscellaneous in this number are of no special interest to our readers.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 137, May, 15, 1869.

The original papers of this number of this periodical are confined to—

A Note on the Aurora Borealis of the 15th of April, 1869.

On Berberis Vulgaris.—M. Schnetzler.

Experimental and Theoretical Researches on the Equilibrium Figures of a Liquid Mass not possessed of any Weight.—M. Plateau.

No. 138, June 15, 1869.

This periodical contains an astronomical paper, unsuitable for abstraction here, and no other original papers; being filled with translations of memoirs taken from *Poggendorff's Annalen*, and other periodicals of that description, the papers having been alluded to and quoted by us already.

Chemisches Centralblatt, No. 20, May 19, 1869.

This number does not contain any original papers or communications.

Bayerisches Industrieund Gewerbeblatt, March and April, 1869.

The greater part of this double number is filled with "Dasr Berggesitz für das Königreich Bayern"—that is to say, a very lucidly and perfectly-made law (act of parliament) for the regulation of everything connected with mining, quarrying, and the extraction, from the earth, of minerals, including coal, limestone, and also building materials, &c., for the kingdom of Bavaria.

Boring of Wells, and the Water Supply to Large Towns.—M. Kieser.—This is a rather lengthy, but highly interesting, essay, on a subject of very great importance.

Experiments on the Bleaching of Wood Pulp for Paper Manufacture.—Dr. C. Winkler. — Neither chlorine, bromine, nor any substances the activity of which is due to oxidation, were found by the author to answer the purpose, the result always being the production of a decidedly yellow, and sometimes even brown, tinge. Sulphurous acid does not completely answer the purpose; the destruction of the natural colouring matters by means of fermentation did not lead, also, to any good result.

Effect of Temperature of the Air upon the Illuminating Power of Burning Coal Gas.—M. A. Vogel.—From this lengthy essay we only notice that, when the illuminating power of ordinarily good coal gas is equal to 100 at 18°, it is only 76 at 0° and 33 at —20°.

May, 1869.

This number chiefly contains officially-published matter, among which are very minute directions for the assay of gold and silver articles of *bijouterie* and the use of proof or touch needles in testing the quality of pure gold and silver contained in articles presented for assay to the parties appointed for this purpose; all such assayers have to pass a very strict examination in general and practical chemistry, and especially in the assay of gold and silver by the dry, and also the wet process, as far as the latter metal is concerned. The touch-needles alluded to are made at the Munich mint, uniformly for the seven assay districts into which the kingdom of Bavaria is divided. This number does not contain any original papers relating to chemistry, or sciences closely related thereto.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, March, 1869.

This number of this periodical, which is always rather behind-hand as regards its time of being published, does not contain any memoirs or papers which bear upon chemistry, or sciences closely allied thereto.

Annales des Mines, vol. xv., 1st part for 1869.

This periodical contains—

A Biography of the Chemist, P. Berthier.—A concise review of his arduously-accomplished and incessant labours. This lengthy paper is concluded by an enumeration of the titles of the memoirs, papers, and books published by this *savant*, which catalogue occupies no less than fourteen octavo pages, printed in small type.

Although not belonging to the subjects usually treated by us, we cannot refrain from calling attention here to an excellent report on a steam boiler explosion, which took place at Moulins-Lille.

The rest of the papers in this number of this periodical bear upon practical mining, and are not of general importance.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliqués a l'Industrie,

Nos. 1 and 2 for 1869.

This very useful periodical is published in Belgium, and its editors are Belgians of high scientific as well as practical attainments. The first paper we meet with in this number is an excellent monograph on the—

Mineralogical Character and the Mineral Value of the Iron Ores of the Province of Luijk (Liege).—M. Franquoy.—From among the large number of analyses which accompany this very lengthy paper, we quote the analyses of a couple of samples of *fer-carbonaté lithoide des houillères*. The first sample contains, in 100 parts:—Carbonate of iron, 73·66; carbonate of lime, 2·98; carbonate of magnesia, 2·06; carbonate of manganese, 3·31; clay, 12·17; water and carbonaceous matter, 5·53; phosphoric acid, 0·29; yield of metallic iron, 34·76 per cent; specific gravity of this sample of ore, 3·15. The other sample contains, in 100 parts:—Carbonate of iron, 56·23; carbonate of lime, 4·84; carbonate of magnesia, 2·93; carbonate of manganese, 0·58; clay, 26·20 water and carbonaceous matter, 9·22; phosphoric acid, a trace; yield of metallic iron, 26·96 per cent; specific gravity of this sample of the mineral, 3·123.

On Saccharimetry.—This paper is a magnificent monograph on this subject, being the result of researches instituted in consequence of the International Convention agreed to by France, the United Kingdom, the Netherlands, and Belgium, on the 8th of November, 1864, in reference to the rules which shall apply to the amount, and mode of payment, of the duties on sugar in these four countries. The paper here alluded to is chiefly the work of Prof. Landolt, of Bonn, and is published by the kind permission of His Excellency the Belgian Minister of Commerce; we regret that it is too full of interesting matter, too concisely written, and, moreover, by far too lengthy for any useful abstraction. As a curiosity rather, and as proving the correctness of the figures adopted by the Netherlands Society of Commerce—whereby raw sugars are designated by the cypher-figures 1, 2, 3, and so on up to 21, according to the degree of purity, and the higher percentage of crystallisable sugar contained in the various samples so designated—we quote the following analysis:—No. 9, in 100 parts—Pure cane sugar, 89·6; organic salts, 4·3; water, 3·8; undetermined substances, 2·3. No. 12, in 100 parts—Pure cane sugar, 93·0; organic salts, 3·7; water, 3·1; undetermined substances, 0·2 No. 15, in 100 parts—Pure cane sugar, 95·0; organic salts, 1·6; water, 2·0; undetermined substances, 1·4 The composition of treacle, in 100 parts, varies between the following limits: Best sample contained—Cane sugar, 61·8; sucrose (*sucre interverti*), 1·9; salts, 18·9; water, 14·2; undetermined substances, 3·2. Worst sample contained—Cane sugar, 54·4; sucrose, 1·6; salts, 19·9; water, 21·0; undetermined substances, 3·1. All the experiments were made on samples taken from quantities several thousand kilogrammes in weight, and they were performed at Cologne, in the establishment of the Rheinischen Actions Verein für Zuckerfabrikation, one of the largest and best-conducted sugar refineries in the world.

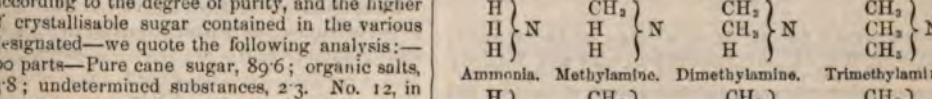
Observations on M. Margueritte's Process of the Volumetrical Estimation of Iron.—M. Léon Moyaux.—This paper ends with the following concisely-stated conclusions, arrived at by the author as result of his experiments:—1st. The normalisation of the permanganate solution can only be properly made by means of metallic iron, and, when the latter metal, in sufficiently pure state for this purpose, does not happen to be at hand, by means of oxalic acid (indirect titration). 2nd. The use of ammonio-sulphate of iron should be rejected; unless, indeed, the precise composition of this salt is repeatedly ascertained, it is not to be relied on, and this testing is a loss of time. 3rd. Repeatedly-continued research is required to ascertain that the solutions of *proto*-salts of iron really keep and continue to be so. 4th. The evaporation of solutions of iron containing hydrochloric or other volatile acids, after the addition of sulphuric acid, always impairs the result of the titration. 5th. The reduction of solutions of *per*-salts of iron to *proto*-salts, after driving off excess of hydrochloric acid, is best effected by means of zinc, better yet by means of amalgamated zinc; but this last metal is to be rejected when a solution of iron happens to contain, at the same time, a proto- and a persalt. 6th. When 0·3 grm. of ore is taken for assay, in case the ore should contain more than 40 per cent of metallic iron (or, when less than that quantity, 0·5 grm. is taken for assay), the quantity of fluid best suited to yield accurate results should not, in either of these cases, respectively exceed $\frac{1}{2}$ or $\frac{1}{4}$ a litre.

The other papers of this periodical relate chiefly to mechanical engineering and machinery.

Chemisches Centralblatt, No. 21, May 26, 1869.

The larger part of this paper is occupied with a treatise on the—

Chemical Constitution of the Organic Hydrocarbons.—M. Kolbe.—The author of this lengthy treatise begins by stating that, however ingenious M. Kékulé's theory may be, that theory is, after all, a failure, and in every respect erroneous. The author next states that, according to his opinion, a solid basis for speculation, on the true constitution of the organic hydrocarbons, is to be deducted from our experience with organic ammonias. The comparison of these two kinds of compounds has made clearly understood to him the nature of di- and tri-carbon acids, in reference to mono-carbon acids; and the organic ammonias, wherein nitrogen and phosphorus equivalently act, are the counterpart and example for the mode of constitution of the carbo-sulpho-acids. Ammonia, H_3N, and marsh gas, H_4C, are, in this sense, comparable, and may be placed side by side, just as, from ammonia, by substitution of the hydrogen atoms for the alcoholic radicals, organic ammonias are produced, which possess basic properties, so, from marsh gas, *carboles* are formed. Ammonia, therefore, agrees (*entspricht*) with the carbol, H_4C; the methylamine, the methyl-carbol, and di- and tri-methylamine agree with the di- and tri-methyl-carbol.



The learned author proceeds, in this manner, with his essay, proving, by a great variety of instances, the truth of his statement; his paper is, however, not well suited for abstraction, and the less so from the fact that, in the above-named periodical, a condensed abstract only is published.

Reduction of Carbonic Acid to Oxalic Acid.—M. E. Drechsel.—Pure and clean sodium, exhibiting a metallic surface, is placed, along with some freshly-ignited quartz-sand, into a clean flask, and a rapid stream of carbonic acid gas is passed into the flask, which, at the same time, should be heated to the temperature of boiling mercury, 662° F. The sodium molten at this temperature yields, on being stirred up with a glass rod, a silvery semi-fluid paste. As soon as the reaction sets in, the metal assumes a purple color, and, after a few hours, is converted into a dark pulverulent mass. Too much heat should not be applied; and, especially towards the end of the operation, great care is required in managing it, since a too high degree of temperature may cause the combustion of the newly-formed product. After having cooled in the flask, the substances therein contained are withdrawn from it, and, having been spread out in a thin layer, so as to effect the oxidation of any small par-

ticle of sodium not yet acted upon, the mass is exhausted with water, the aqueous solution saturated with an excess of acetic acid, and, after having been filtered, precipitated with chloride of calcium; the precipitate thus formed is always rather brownish coloured. It is dissolved in hydrochloric acid, filtered while yet hot, and precipitated with ammonia, whereby the salt, oxalate of lime, is obtained perfectly snow-white; 60 grms. of sodium yield, by this process, 6 grms. of pure oxalate of lime. Instead of sodium, a potassium-amalgam, containing 2 per cent of the alkali metal, and otherwise treated in the manner just described, yields a fair percentage of oxalate of potassa.

Nos. 22 and 23, June 2 and 9, 1869.

These two numbers do not contain any original memoirs, papers, or communications.

Bulletin de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 4, 1869.

The only treatise contained in this number relating to chemistry is the first portion of an essay on the—

Isomerism of the Salicylic Series.—M. L. Henry.—The first section is headed—*Chlorinated Derivatives from Salicylic Aldehyde.* The derivatives of the *mono-substitués* of toluen and benzoic acid are pretty well known, and ought, according to this author, to be separated into three distinct groups, designated respectively—*ortho*, *para*, and *meta* series, each of these embracing a peculiarly characteristic monochlorinated benzoic acid, $C_7H_5ClO_2$, and a diatomic acid, $C_7H_6O_3$. The author also proposes to name each of the three groups already alluded to—the *benzoic*, or *oxybenzoic*; the *dracylic*, or *paraoxybenzoic*; and the *salylic*, or *salicylic* series. Of each of these series, a large number of very complex formulæ are given, but the paper, however interesting in a purely scientific point of view, is, on account of its length, and on account of the large space which the quotation of the formulæ would require, not quite suitable for further abstraction.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 9. May 23. 1869.

We notice the following original papers from this periodical:—

Contribution to our Knowledge of the Doubly Coupled (Geparte) Compounds of Inorganic Chemistry.—M. C. W. Blomstrand.—In the introduction to this paper, the author refers to a published work of his, to which the title "Die Chemie der Jetztzeit" (the chemistry of the present day) is given. Next, he states that, when explaining and settling the question about coupling, he mentioned some experiments of his on the behaviour of iodine towards yellow prussiate of potassa, which were not quite successful. The author next proceeds to review the ammonia compounds of platinum, and says that he considers the so-called platinocyanide of chloride of potassium, $2KCl+PtCy_4$, to be the perfect analogue of Grosses's base, which manner of viewing may be made evident by giving to the respective formulæ of these substances the following form:—Grosses's base—

$$(Cl—NH_2—NH_2)2\,Pt_4Cl_2;$$

platino-cyanide of chloride of potassium—

$$(K—Cy—Cy)2Pt_4Cl_2.$$

The author next proceeds to describe a lengthy series of researches on this subject, but his paper, an abstract of an abstract and *vivâ voce* communication by Dr. H. L. Buff, at the meeting of the Society, is too full of formulæ to be suitable for further abstraction.

On Binitro-Cresol.—MM. Martius and Wichelhaus.—There is met with in commerc, under the name of Victoria yellow, or aniline orange, a reddish powder, which yields highly yellow-coloured solutions, and bears, in general, great likeness to the binitro-naphthol compounds. The authors have instituted some researches on this material, and have found it to be a nearly pure binitro-cresol salt. The binitro-cresol they separated from it is readily soluble in alcohol, ether, chloroform, and boiling water; it may be obtained in crystalline shape; the dry substance fuses at about 110° C.; the silver salt is rather difficultly soluble, and may be obtained in crystals. The authors have tried in vain to obtain, by the experimental method, a clue to the mode of manufacture and origin of this material. The solutions of binitro-cresol become gradually deep-red coloured on exposure to air, and also when chloride of iron is added to the same.

Some Derivatives from Phenylacetic Acid [a Toluylic Acid.—M. B. Radziszewski.—The author first describes the method whereby he prepared this acid; we need need not repeat this, as the author says it is well known, and is that used by Canizzaro. The methyl ether of this acid is a colourless liquid of 1·044 sp. gr. at 16°; it boils at 220°, without decomposition. The ethyl ether of the above-named acid is a liquid, having a sp. gr. of 1·031; it boils at 226°. The author next proceeds to describe the action of bromine upon the *a* toluylic acid; then the action of bichromate of potassa and dilute sulphuric acid; next, the action of chlorine, of nitric acid, and other chemicals; and winds up with saying—"The result of my researches is, that the *a* toluylic acid behaves with the haloids, and with nitric acid, as does toluol, giving rise, chiefly, to the formation of para products."

On the Pyromucic Acid Group.—M. Limpricht.—This paper could not be understood without the reproduction of the woodcut annexed to it.

Action of Sulphuric Acid upon Polychlorated Hydrocarbons.—M. A. Oppenheim.—When ethelyn-chloride is acted upon by sulphuric acid, at the ordinary temperature of the air, and at 100°, in sealed tubes, no action whatever ensues; at 130°, however, decomposition takes place, carbon is separated, sulphurous acid formed, and hydrochloric acid generated. When chlorobenzol, $C_6H_5.CHCl_2$, is mixed, at the ordinary temperature, with sulphuric acid, hydrochloric acid is given off without causing a colouration of the liquid; but, at 100°, complote decomposition sets in, and carbonaceous matter is deposited. A syrupy product of this decomposition may be obtained, exhibiting a fluid having a constant boiling point at 175°; its smell is akin to that of the essential oil of bitter almonds.

Constitution of Epichlorhydrin.—M. L. Darmstädter.—The author states that, according to his opinion, the formula of epichlorhydrin has to be written—

$$O\begin{matrix}CH_2Cl\\CH\\CH_2.\end{matrix}$$

Next, he mentions some experiments, in order to prove that the oxygen of epichlorhydrin is combined, by double affinity, to carbon, and is not present therein as hydroxyl. To prove this, he states, at length, what action bromine and chloride of phosphorus exert upon substances containing hydroxyl; and then he gives an account of the action of these two chemicals upon epichlorhydrin. One of the results of this reaction is a liquid, which, in 100 parts, contains:—C, 15·22; H, 2·11; Cl, 15·01; Br, 67·65.

Constitution of the Native Combinations of Tantalum and Niobium.—M. C. Rammelsberg.—This paper is more of mineralogical than chemical interest; and, being an abstract from a large essay on this subject, is not well suited for further condensation.

On Dinitronaphthalin.—M. A. de Aguiar.—The author states that, when dinitronaphthalin is prepared from naphthalin, an isomer thereof is formed at the same time, which, being readily soluble in alcohol, may by that means be separated from the non-soluble variety. The variety soluble in alcohol the author calls *β* dinitronaphthalin; it is a crystalline solid substance, containing, in 100 parts:—C, 55·04; H, 2·75; formula, $C_{10}H_6(NO_2)_2$. The solutions of this substance become red on exposure to the atmosphere, and also on being treated with ammonia; treated with nitric acid, trinitronaphthalin is formed.

Annalen der Physik und Chemie, von Poggendorff, No. 4, June 1, 1869.

This periodical contains, as usual, a large number of original essays, for, in reality, the labours of the authors are rather essays than papers. The first we meet with is—

A Contribution to our Knowledge about Thunderstorms.—M. W. Bezold.—Although this is a meteorological subject, we call attention to this paper, in compiling which the author has made use of the records of insurance companies in Bavaria and Austria, and also of some local statistics collected in the towns and districts, and has applied these materials for the purpose of making a valuable essay on a subject which, as he rightly remarks, cannot be so well elucidated by the observations made at the meteorological observatories, these being too few in number and too far distant from each other. Between the years 1844 and 1865, no less than 1142 buildings, among the large number of those insured against accidents by fire, in Bavaria, were struck by lightning; this is in the proportion of forty-four buildings struck by lightning each year, upon 1,000,000 of buildings insured. The essay, from which we cannot abstract more, on account of its subject matter being foreign to the subjects treated of in our paper, deserves the attention of those whom it may concern in many respects.

On Leucitstone, as it occurs in a Peculiar Ore-Bearing Rock.—M. F. Zirkel.—This communication is a purely mineralogical essay, the subject of which is, beside, of local importance, only referring, as it does, to a single locality.

Certain Phenomenon of Refraction of Light first Observed by Quincke, and Changes of the Rays of Light during Total and Metallic Reflection.—M. E. Jochmann.—This, being an entirely mathematico-physical essay, is not suitable for abstraction.

Meteorites Deposited and Kept in Museums.—Dr. Buchner.—This is the fourth and concluding portion of a lengthy essay on this subject, compiled, in great measure, from previously published papers dispersed through a series of periodicals.

A Hitherto-Unobserved Electric Powder Figure.—M. Kundt.—The author, referring to the well-known Lichtenberg figures, caused by electricity when very finely-powdered substances, such as Lycopodium, are applied to an isolator, states that he has discovered a new kind of these figures, formed on a conducting surface, and less dependent than the Lichtenberg figures upon the peculiar kind of electric developer to be used. The author describes, at length, the various means by which he obtained these figures.

Determination of the Specific Heat of a Constant Bulk of Air by means of the Metallic Barometer.—M. Kohlrausch.—A mathematico-physical essay.

Trigonal Pyramid ξ on the Quartz from Baveno.—Dr. Becker.—A mathematico-crystallographic essay.

Composition of Hydrofluocerite. — M. Nordenskjold.—The author says this mineral, which contains fluoride and cerium, was discovered in the year 1838, at the Bastnäs quarry, near Riddarhyttan, Sweden, and then analysed by M. Hissinger. The author further states that, when he resumed the researches of this mineral, he found that its earlier investigators had made a mistake as to its containing water, of which it contains a mere trace; and, next, he records the mode of his researches of the mineral now named by him *hamartite*, from the Greek ἁμαρτω, to err. The result of his analysis is, that this mineral contains, in 100 parts:—Oxide of lanthanum, 45·77; oxide of cerium, 28·49; carbonic acid, 19·50; water, 1·01; fluorine, 5·23. Formula, $CeFl+2(LaO, CeO)CO_2$.

Grain Test for Bin-Axial Mica.—M. E. Reusch.—A crystallographical essay.

Discovery of Large Crystals of Quartz in a Very Difficultly-Accessible Portion of the Swiss Alps.—This paper is a reproduction from a newspaper published at Berne, and describes the cavern wherein these crystals were found; one of these weighs 267 lbs., is 69 centimetres in height, and has a circumference of 122 centimetres. This may suffice for this subject.

The editor of the *Annalen* very properly calls attention to a most useful work, now in regular course of publication under the auspices of the Prussian government—viz., the *Repertorium der Technischen, Mathematischen, und Naturwissenschaftlichen Journal-Literatur*. This most useful work, to which we may add the index of foreign scientific periodicals, will, as justly observed by the editor of *Poggendorff's Annalen*, keep the place of a permanent and periodically published supplement to the catalogue of scientific papers published by the Royal Society. The repertorium records the titles of the papers of some 150 periodicals, in all languages, and published over the whole world. It may be inspected at the Library of the Commissioners of Patents, where it is regularly taken in.

Annalen der Chemie und Pharmacie, June, 1869.

Contents:—

Action of Boiling Liquids containing Acids and Alkalies upon Glass and Porcelain Vessels.—Dr. A. Emmerling.—This essay, or rather monograph, contains the record of a series of most minutely-executed experiments, whereby to determine the influence of various fluids, containing acids, salts, and alkalies, upon vessels made of different qualities of glass and porcelain, in order to determine the amount of substance dissolved by such chemicals, and also by pure distilled water, and to ascertain what influence is thus exercised upon the accuracy of analysis and chemical researches in general. This monograph is full of interesting details, including analyses of glass. *En résumé*, its leading features are the following:—The action of boiling liquids, as specified above, upon glass vessels is proportionate to the duration of time of boiling; the action is proportionate to the surface which is in contact with the boiling fluid; the action is independent of the quantity of fluid which evaporates during a given time; the action decreases with the decrease of temperature of the solution; alkalies, even in dilute solutions, attack glass very strongly; acids generally act less than pure water, excepting sulphuric acid; among the salts, those act most energetically whose acids produce insoluble salts with lime—*e.g.*, sulphate and phosphate of soda, carbonate of soda, and oxalate of ammonia, the action of each of which increases with the degree of concentration of the solution; such salts as form, in water, readily-soluble lime-salts—for instance, the chlorides of ammonium, potassium, calcium, and nitrate of potassa—less strongly than pure water alone, and, with the greater degree of concentration of these salts, the action decreases. Bohemian glass stands acids better than the kinds of glass containing soda; the Berlin porcelain ware is only perceptibly acted upon by alkalies.

Researches on the Isomers of the Benzoic Series (ninth monograph, containing "The Chlorinated Derivatives of Toluol.")—MM. Beilstein and Kuhlberg.—This essay is too lengthy for abstraction; the subject, moreover, has been already obstracted from another German publication.

On Oxylohydroxamic Acid.—Dr. H. Lossen.—This acid is a solid substance, difficultly soluble in cold water; submitted to a higher temperature it is slowly decomposed; when suddenly heated to 105°, it detonates; boiling for a length of time with water does not decompose it; on being boiled with caustic potassa solution it is converted into oxalic acid: nitric acid decomposes it completely and very rapidly. This acid consists, in 100 parts, of:—C, 20·00; H, 3·33; N, 23·33; O, 53·34. Formula, $C_2H_4N_2O_4$. The author describes, at great length, a series of salts of the oxylohydroxamic acid.

Researches on Mesitylen (sixth series).—Some Newly-Discovered Derivatives of Mesitylen.—MM. Fittig and Hoogewerf.—This essay has been noticed by us already, since an abbreviated account of the subject herein referred to was published in another German periodical published previous to this number of the *Annalen*, and noticed by us.

Chemical Constitution of Glycerine and its Derivatives.—M. Kolbe.—The learned author of this monograph starts from the hypothesis that glycerine should be equal to—

$$\left.\begin{matrix} CH_2 \\ CH_2.HO_{11} \\ HO \\ HO \end{matrix}\right\} C;$$

and next states that glycerine contains the elements of two groups of methyl, constituted in the following manner:—

$$\left.\begin{matrix} CH_2.HO \\ CH_2.HO \\ H \\ HO \end{matrix}\right\} C, \quad \text{and} \quad \left.\begin{matrix} CH.(HO)_2 \\ CH_3 \\ H \\ HO \end{matrix}\right\} C.$$

The author then reviews such a lengthy series of compounds, and takes such extensive excursions over the immense field of organic chemistry that it is impossible to compress into a small space even a minute fraction of this monograph, to which, therefore, we will not allude any further, especially as it is more a philosophico-chemical dissertation on an abstruse subject than of direct practical application.

Journal für Praktische Chemie, No. 7, June 15, 1869.

The following original papers are found in this periodical:—

On Sanguinarin, its Properties and Composition.—M. Naschold.—Sanguinarin is so named because it is prepared from the *Sanguinaria canadensis*, but it also occurs in the *Chelidonium majus* and *Glauceum luteum;* it is an alkaloid, which, in pure state, is a crystalline, white-coloured solid; formula, $C_{17}H_{15}NO_4$. As a peculiarity, the author observes that the estimation of the nitrogen contained in this substance cannot be satisfactorily executed with the well-known soda-lime process, but has to be performed by Dumas's method. The author describes, at length, several combinations of sanguinarin with the chlorides and cyanides of platinum, its behaviour towards reagents, and its products of decomposition, but none of these are so precisely characteristic as thereby to render it easy to distinguish and detect sanguinarin from all other alkaloids.

Brandy obtained from Reindeer Moss.—M. Stenberg.—This paper contains, translated from a pamphlet published in Swedish, a more extensive account of a subject to which, some time since, we referred in our columns, and since it is of no importance, except where the *Cladonia rangifera* is found, we make no further abstract of this paper.

Estimation of Sulphur.—Dr. G. J. Mulder.—The author speaks of the estimation of sulphur in such substances which contain carbon and sulphur together, and are not very volatile, and are, at the same time, free from any ash or incombustible matter. A certain quantity of the substance wherein the sulphur has to be estimated is weighed off in a porcelain capsule; there is next added a weighed quantity of finely-powdered nitrate, or acetate of lead; next, some nitric acid, the strength of which depends upon the nature of the substance to be assayed; and, lastly, a few crystals of pure nitrate of ammonia are added. The contents of the porcelain vessel are now carefully evaporated to dryness, ignited, and weighed. Since the weight of the oxide of lead derived from the acetate or nitrate employed is known, the increase of weight of the capsule and contents is due to the sulphate of lead which has been formed from the sulphur originally contained in the substance submitted to experiment. This method also yields accurate results, when, besides sulphur, there may be iodine and bromine present, and also lead; the method may be used, also, for the estimation of phosphorus, when, in substances containing both that element and carbon, it is desired to estimate the former quantitatively, provided, of course, sulphur be absent.

Products of Decomposition of Legumin when Boiled with Sulphuric Acid.—M. Ritthausen.—The author states that, while he was engaged studying the products of decomposition of legumin and conglutin, he discovered a nitrogenous acid, which contained, in 100 parts:—C, 39·46; H, 6·14; N, 12·04; O, 42·36. This acid was called by the author leguminic acid. On resuming his investigations on this subject, he finds, as explained in this paper, that the acid just alluded to is a mixture of two amine acids—to wit, asparaginic acid, $C_4H_7NO_4$, and glutaminic acid, $C_5H_9NO_4$; both these acids are homologous—both are solid crystallisable substances, yielding, among their products of decomposition, by the action of nitric acid, malic and glutanic acids.

Gewerbsblätter für das Königreich Würtemberg, Nos. 5 and 6, 1869.

This periodical rarely contains anything but matters relating to applied mechanics and agriculture; in this number, however, we meet with a paper:—

On Cyanine.—M. Morat.—The author says that the colouring matter of flowers consists—1st, of cyanine, or a blue pigment; 2nd, a rose, or pink-coloured matter, in reality identical with the first, and only altered by an acidity of the juice; 3rd, two yellow-coloured matters—xanthine, insoluble in water, and xanthéine, soluble in that liquid. Cyanine is best prepared from the petals of violets or iris flowers; by exhausting these with boiling alcohol, a blue solution is obtained, which solution, however, soon turns brown, but is restored to its primitive colour by being shaken up in contact with air. In order to obtain the colouring matter in a pure state, the alcoholic solution is evaporated to dryness on a water-bath, and the residue taken up with water, wherein the blue pigment is soluble, while fatty matter and resins are left behind; the aqueous solution is precipitated by acetate of lead; the ensuing green-coloured precipitate is decomposed by sulphuretted hydrogen, filtered and washed, and the filtrate next evaporated to dryness upon a water-bath; the residue is exhausted with absolute alcohol, and the cyanine precipitated from its solution therein by ether. Cyanine does not crystallise, is soluble in water and alcohol, and insoluble in ether; acids turn it red, and alkalies green—it is a very highly sensitive reagent for both. Reducing agents decolourise cyanine; oxygen restores the colour. The red colouring matter of flowers is extracted in a similar manner, and, once isolated, exhibits characters identical with cyanine.

On Oenoline.—M. Morat.—Oenoline is the colouring matter met with in genuine red wines obtained from grapes; it is obtainable by treating the wine with basic acetate of lead; the ensuing precipitate is collected on a filter, washed, dried at 100°, and placed in a displacing apparatus, and while therein there is poured over the dry precipitate anhydrous ether, previously saturated with dry hydrochloric acid gas. There runs off a brown-coloured liquid; the precipitate is washed with anhydrous ether until what runs off ceases to have an acid reaction. The residue in the displacing apparatus, which now exhibits a bright red colour, is treated with alcohol of 36° Beaumé, which thereby assumes the same bright red colour. The alcoholic solution is concentrated by evaporation to a small bulk, and water is next added; this causes the colouring matter to precipitate as a red-coloured flocculent substance, insoluble in ether, very difficultly soluble in water, soluble in alcohol, and insoluble in benzol. By a long-continued boiling in water this colouring matter is changed, becomes brown, and loses its solubility in alcohol. The solution of the unaltered red pigment in dilute alcohol exhibits the following reactions:—Chlorine water and chlorine gas destroy the colour, producing thereby a yellow substance soluble in water; caustic potassa causes, first a blue, and next a brown colouration; lime-water yields a yellowish precipitate; bicarbonate of soda in aqueous solution, and aqueous solution of chloride of calcium, cause a blue colouration; solution of alum causes a brighter red colouration; hydrochloric acid effects no change; with nitric acid, a yellowish flocculent matter is thrown down; acetate of lead causes a blue precipitate; nitrate of lead produces a violetish red

precipitate; acetate of copper yields a chestnut-brown coloured precipitate. This red colouring matter is composed according to the following formula:—$C_{16}H_{10}O_8$. Young red wines contain, moreover, a pigment, soluble in acetic and butyric ethers, with a bluish violet colour, becoming green by ammonia, and finally turning brown. Some chemists consider that this material is identical with cyanine; it is not a very stable compound, and is only met with in young wines. The colouring matter of wine is of some interest, as affording a means for detecting adulterations and artificial substitutes of wine.

Polytechnisches Journal von Dingler, second number for May, 1869.

Among the original papers, other than those relating to mechanical art and purely practical engineering, we meet here with a lengthy essay on the—

Conditions which are required for the Formation of Hypochlorite of Lime.—MM. Tschigianjanz, Fricke, and Reimer.—The authors, who have most thoroughly investigated this subject, begin their essay with the statement that, in practice, as well as in theory, a real influence has been ascribed to the moisture and state of hydration of the slacked lime which is submitted to the action of the chlorine gas; next, they review the opinions and labours on this subject of MM. Weisz, Morin, and Houton-Labillardière, Dr. Ure, Dr. Muspratt, Prof. T. Graham, and, lastly, Dr. Bolley. Curiously enough, the opinions of these learned gentlemen vary, and even to such an extreme that, whereas some of them assert that dry hydrate of lime (slacked lime) is capable of taking up 40, or even 50 per cent of chlorine gas, some of them declare that hydrate of lime, dried at 109°, does not take up any chlorine gas at all. The authors of this essay, fully convinced that men of eminently high standing in scientific matters, and especially Prof. T. Graham, were not likely to err in their observations, were led by an observation, made by the last-named *savant*, that lime dried over sulphuric acid in the vacuum made by an air-pump behaved differently towards chlorine gas from that dried at 100°. To investigate this subject fully, the authors of this essay commenced by procuring good pure caustic lime, a matter of far more difficulty than one would imagine at first. They succeeded in obtaining this material by taking the caustic quick-lime of commerce, made from pure mountain limestone, soaking that material with oil, and burning or igniting it a second time, after having placed it in a crucible heated in a furnace with coke and charcoal, and a strong blast produced by a pair of blacksmith's bellows. Quick-lime, thus prepared, when placed in water, is instantaneously converted into hydrate of lime, while there is produced, at the moment of contact of the quick-lime and water, a hissing noise, as if of a piece of red-hot iron quenched with water. The authors also prepared a quick-lime from pure white marble, soluble in very dilute hydrochloric acid, without residue; they took care that, whenever they dried the hydrate of lime intended for their experiments, to exclude the access of carbonic acid gas from that hydrate. They next repeated Prof. T. Graham's experiment, working comparatively drying weighed quantities of slacked lime over sulphuric acid, as well as by means of heat, passed chlorine over these quantities for 1½ hours, and expelled excess of that gas, left uncombined by means of a current of dry air free from carbonic acid. The results of their extensive labours are:—1st. Slacked lime, retaining even as small a quantity as 0·4 per cent of water (as is the case with that dried over sulphuric acid *in vacuo*), and any larger quantity of water retained is sufficient to effect the formation of hypochlorite of lime at any temperature. 2nd. Hydrate of lime, dried at 100°, or even at 130°, is converted into hypochlorite of lime, even at 0° (32° F.), provided the lime is freely allowed to become heated by the absorption of chlorine gas; but, if by means of keeping the temperature at 0°, or even lower, the lime is prevented becoming heated, no action at all, or only a very slight one, took place. The authors call attention to the often-overlooked fact that it is very difficult to obtain a chlorine gas quite free from hydrochloric acid gas, against which they have taken peculiar precautions in the course of the experiments just alluded to.

Behaviour of Chlorine, Iodine, and Bromine towards a Solution of Permanganate of Potassa.—M. W. Lindner.—The author says, when, to any solution containing a compound of iodine, a drop of a dilute solution of permanganate of potassa is added, the peculiarly characteristic colour of the latter substance is changed into brown—that is to say, that iodine is set free and the permanganate reduced. It does not matter whether the original solution of the iodide has an acid or an alkaline reaction, for, in the former case, the fluid will be clear and transparent, in the latter turbid. A neutral solution of a bromide is not affected by the permanganate, neither is an alkaline solution; but if the solution of the bromide is acidified with nitric acid, the reaction, on addition of the permanganate, takes place in the same manner as for the iodide solution. A solution of a chloride is never, under any conditions, acted upon by the permanganate. The author states that, even when solutions of iodides or bromides are so dilute as hardly to be detected by nitrate of silver, the permanganate never fails to detect the presence of them, but does not, at the same time, distinguish between iodine and bromine, for which purpose the specially-distinguishing reagents for these two halogens have to be applied.

Les Mondes, July 8, 1869.

We find in this paper the following original communications:—

Agronomical Map of France.—M. Delesse has received, from every canton the empire is subdivided into, two average samples of the arable soil of each of these small districts, taken at a depth of 15 centimetres below the surface. The author has thus in hand 6000 samples, and proposes, after chemically and mineralogically testing and classifying them, to employ the information thus obtained in constructing an agronomical map of France, whereupon the nature of the soils of the divers localities will be clearly indicated.

Electrical Phosphoroscope.—M. Laborde.—This instrument is based upon the same principle as that of M. Becquerel; its essential parts are a Ruhmkorff induction apparatus, the spark of which throws light on the phosphorescent object, and of a sliding frame, one of the ends of which hides the object during the brief moment it is illuminated by the electric spark. This sliding frame is 40 centimetres in length by 10 centimetres in breadth; it is fixed at its centre on an axis, which may be made to move rapidly by means of a pedal. The arrangement of this apparatus, which is rather confusedly described in the original, and could not be well understood without a diagram, is such as to render it serviceable for studying the phosphorescence excited by a blow, as well as by friction. The phenomena of phosphorescence of substances which, like nitrate of uranium, is only of very short duration, can be observed by means of this instrument equally well as the long-continued and strong phosphorescence induced by friction in pieces of porcelain or glass.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 197, May, 1869.

The greater part of this periodical is devoted to mechanical science. The only paper of interest to chemists is a lengthy report on the—

Manufacture and Use of Animal Phosphated Chlorinated Manure.—Dr. Boucherie.—All farmers know that now and then it happens that horses, cattle, or sheep die; and it is chiefly the disposal of their carcases which the report here alluded to treats of. The skin is taken off, and, after having been disinfected, is sold; the

intestines are mixed with quick-lime, and buried in a spot to be always kept for such a purpose; the remainder of the carcase is cut into pieces weighing from 5 to 6 kilos., and placed in a wooden tank lined inside with lead, and of about 120 cubic feet capacity. Water is added to the remains of the dead beast, bones included, and about 400 kilos. of crude commercial hydrochloric acid; ebullition is effected by means of the introduction of steam, obtained from the portable steam boiler; after boiling for about six hours, the entire mass is disintegrated. In order to destroy the very unpleasant smell resulting from this ebullition, some lumps of peroxide of manganese are added, whereby a slow but constant disengagement of chlorine gas, is obtained, and all disagreeable smell avoided. When the liquid and contents of the tank are thoroughly cold, the solidified fat which floats on the top is taken away, and fit for the soap or candle maker; the clear liquid is run off and mixed with 200 kilos. of coprolite powder, or bone-ash, and thus converted into a useful manure. At the bottom of the tank will be found a brownish-coloured pulpy mass, which has lost all traces of organised structure, and this material, after having been mixed with some mineral phosphate, is also applied as manure. The following is the composition, in 100 parts, of the liquid manure here alluded to, previous to its being mixed with mineral phosphate:—Water, 79·60; organic matter (containing 1·28 per cent of nitrogen), 10·65; ash (containing 2·38 per cent of phosphoric acid), 9·45. The brownish pulpy mass contains, in 100 parts:—Water, 16·75; organic matter (containing 3·90 per cent of nitrogen), 31·17; ash (containing 8·20 per cent of phosphoric acid), 52·08. The quantity of materials obtained at each operation is stated to amount to about 70 kilos. of fat, 1500 litres of liquid, and 700 kilos. of brownish pulpy animal matter; these quantities, however, will vary according to the size, weight, and nature of the animals so disposed of. This process is recommended above the burial of dead animals; and in some communes of France, it is already ordered to be adopted in all cases, since it is a useful addition to the sanitary regulations of the country.

Programme de la Société Hollandaise des Sciences de Harlem, Année, 1869.

On the 15th of May, the general yearly meeting of this scientific society was held at Harlem. The meeting approved of the proposal made by a committee, to found two additional medals, each of the intrinsic value of 500 florins (about £42), one of which will bear the name and effigy of Huyghens, the other that of Boerhaave. These medals are intended to be given, every alternate two years, to those scientific men, native or foreign, who, by their researches, discoveries, or inventions, shall, according to the opinion of the Society, have most contributed, during the last twenty years, to the advancement of a specific branch of physico-mathematical, or natural history sciences. The Huyghens medal will be awarded, in 1870, to natural philosophy; in 1874, to chemistry; in 1878, to astronomy; in 1882, to meteorology; and in 1886, to mathematics (pure and applied). The Boerhaave medal will be awarded, in 1872, to mineralogy and geology; in 1876, to botany; in 1880, to zoology; in 1884, to physiology; and in 1888, to anthropology. The preliminary award shall be made according to the advice of a committee to be appointed by the directors of the Society, of which committee the secretary of the Society shall be a permanent member. The final award shall be made at the general yearly meeting of the Society, after it shall have discussed the report and heard the full explanation given by the committee just alluded to.

Among the questions open for competition, and to be answered on or before the first of January, 1871, we notice the following:

The Society asks for an accurate description of all chemical or physical operations, whereby either accidentally, or as consequence of direct experiments, chemical compounds been obtained, which, by their chemical and physical properties, agree with native minerals. The Society does not desire that new minerals should be artificially formed, but simply an accurate and critical review of the results already obtained; while it is also requested that all the published and printed memoirs wherein such artificially-made minerals have been described shall be fully mentioned.

The Society desires a monograph on albuminous substances; this work to include an historical sketch of all the researches made concerning these substances, and a critical review of the divers opinions which, at the present day, are current in science in reference to these materials.

The Society desires that the co-efficients of expansion, by heat, of divers kinds of glass, and more especially the glass used for making thermometer tubes, be very accurately determined, according to M. Fizeau's method, for temperatures according to the centigrade scale, from —30° downwards to 500° upwards.

Since more recent researches appear to confirm the opinion that the substances known as hydrates of carbon are polyatomic alcohols, the Society desires that new researches be made in order to clear up and fully elucidate this point.

Since the accurate determination of temperatures above 350° is a matter open to great improvement, the Society has decided to grant its gold medal to him who shall succeed in the construction of a simple apparatus whereby temperatures up to 500° are correctly indicated.

The Society asks accurate determinations of the various indices of refraction of water, for at least 12 points of the spectrum, over a range of 50°.

It is well known that the Aurora Borealis causes telluric electric currents, which occasionally disturb the proper action of the electric telegraph wires; the Society desires that, on telegraphic lines of great length, the force of these currents be determined, and that it be also ascertained how far these currents extend towards the equator.

The two questions which the Society desires to receive replies upon, on or before the 1st of January, 1873 (both bearing upon natural history), we need not quote, but specially notice the following questions to which answers are expected on or before the 1st of January next, these questions having been propounded and published last year:—

Since it cannot be denied that spectrum analysis, now almost the order of the day, has been overrated, and its value exaggerated, it is desired that, in order, also, to obtain more sound views on this matter, that which is true and that which is false therein be equitably sifted; that the limits be stated up to which this method is of legitimate use, and beyond which it fails to be applicable; and, lastly, that a critical review be made of all facts brought to light by this branch of experimental research, and, also, that it be pointed out what science has to expect of its extended application.

The electric current heats the metallic conductor which is traversed by it; hence the resistance the current experiences is increased, and in this manner the current reacts on itself. We may, on the other hand, suppose that the intensity of the current modifies the value of this resistance by virtue of an action which does not directly depend upon the heating. It is desired that the influence exercised by the intensity of the electric current on the degree of resistance be investigated in both points of view just mentioned. Among the metals which seem to offer the best chance of success for this kind of investigation, mercury holds a prominent place.

The repetition, extension, and criticism is asked of the experiments concerning the electrolysis of the fused haloid salts (Faraday's "Experimental Researches," T. I., art. 538 and following, and 978 and following); also an *exposé* of the theories of the nature of electrolysis which can be deduced therefrom. Faraday's law of electrolysis is very simple; but the question is not yet exhausted, and the whole phenomenon is obscure. It is therefore desired that it should be rigorously decided up to which point the above mentioned experiments are in opposition with this higher view, and aided by a great many facts, according to which no real electrolysis whatever should take place unless the action of the current be only

[English Edition, Vol. XX., No. 504, page 48; No. 505, page 57.]

exerted upon double salts, or upon combinations equivalent and analogous therewith.

According to M. G. Ville (see his *Revue des Cours Scientifiques*, 1868, No. 7, p. 103), nitrogen, in its free or elementary state, should be assimilated by some kinds of plants, especially those belonging to the *Leguminosæ*; the Society therefore asks that this opinion be submitted to a critical examination, and that the truth or falsity of this opinion be fully made out on theoretical as well as on experimental ground.

In reference to the extremely interesting and highly-valued experiments of Mr. Graham, Master of the Mint, the Society asks for new researches on the absorbing and dissolving power of molten metals for hydrogen gas, especially with the view to determine whether there do exist definite combinations of hydrogen and metals. The Society desires to have experiments made with various metals, in order to ascertain, with certainty, the fact whether the assertion that metals become transparent at a sufficiently high temperature holds good, or is to be rejected.

Since there yet exists a great deal of uncertainty on the subject of the cause of the phosphorescence of substances called artificial phosphori, the Society requests that a thorough research be made to establish the fact that this phosphorescence is only due to a slow oxidation.

Whilst the pressure of the air, the direction and force of the wind, and the temperature of the air are continuously recorded at the meteorological observatories, by means of self-acting and self-registering instruments, the degree of moisture of the air is as yet only recorded by a few isolated observations made at certain hours of the day-time. The Society desires the construction, either upon an entirely new plan, or according to the principles indicated (see *Poggendorff's Annalen*, vol. xciii., p. 343), of a self-acting or self-registering instrument for determining the degree of moisture of the air, and the publishing of results of observations obtained by means of such instrument for at least one half-year continuously.

The Society desires to recommend, to the competitors for prizes, to omit, in their answers to questions, any matters not directly relating to the proposed question; it is, moreover, desired that, whatever be sent into the Society should be worked out with precision, and that every proposition be well defined and demonstrated, and not mixed with vague theories or badly digested and not well established facts. The memoirs sent in must on no account whatever be written in the handwriting of the authors themselves, since, if even these memoirs might be worthy of the award of the medal, and it turned out that such documents were written in the author's own handwriting, no award whatever could be made, according to the Society's rules. The envelopes added to the memoirs sent in, and appended thereto by a peculiar mark, and containing the author's name, will, in case no award is granted, be destroyed by fire, unopened. The memoirs to be sent in for competition may be written in Dutch, French, Latin, English, Italian, or German languages, at the author's option, provided, in the case of the German language, the italic, and not the peculiar German mode of writing, be used. All such documents, and the envelopes appended thereto, and just alluded to, should be sent, carriage or postage paid, to Dr. E. H. von Baumhauer, the Secretary of the Society, residing at Harlem, North Holland, Netherlands.

The prize offered for a satisfactory memoir, or answer, to each of the proposed questions, is the Society's gold medal, value 150 florins (£12 10s.), bearing the author's name and the year of issue, or, if the author might desire it, the full money value of the medal; in some cases, it is left to the umpires of the awards to grant an additional award of 150 florins. The competitor to whose memoir a prize shall have been awarded may not, without the express consent and authorisation of the Society, print or publish, either in whole or part, separately or in any periodical, the memoir to which the prize has been awarded.

Polytechnisches Journal von Dingler. vol. cxcii., No. 5, first part for June, 1869.

We notice the following original papers and communications in this number:—

Researches made in the Laboratory for Technical Chemistry at Brunswick.

a. **Abnormal Behaviour of Saccharate of Lime.**—M. Waldeck.—It is a well-known fact that the combination of lime and sugar yields, with cold water, a clear solution, which, on being heated, becomes turbid, or even gelatinises. A solution having been prepared, by mixing, with a solution of pure sugar in water an excess of slaked lime, shaking this mixture, and afterwards filtering it; on heating this solution, no turbidity ensued at all. This phenomenon gave, of course, rise to further investigation, when it was found that the lime which had been applied in this instance was chemically pure hydrate of lime. On mixing some of the same sugar solution with lime as ordinarily obtained from lime-kilns, it was found to exhibit again the phenomenon of becoming turbid on heating. At first sight, therefore, it would appear as if chemically pure lime behaved differently with sugar solution from what ordinary lime does; but further investigation into this matter brought to light the fact that, owing to the necessity of obtaining a fresh supply of sugar, this substance, and not the lime, was the cause of this discrepancy. The author found that, although at first sight no difference could be detected in the refined sugars applied, yet the last-obtained sample behaved, both with the chemically pure and ordinary lime, in the same manner, yielding a solution which becomes turbid on heating; both kinds of sugar were refined white loaf sugar obtained from the same place and at the same price. Of the first sample, yielding abnormal results, unfortunately no more was obtainable, and therefore the matter remains in some obscurity; but those who are connected with sugar refineries might take this hint, and, perhaps find a valuable means of distinguishing between various samples of refined sugar.

b. **Manufacture of Soda from Sulphate of Soda and Oxide of Iron.**—M. Waldeck.—The author points out that the manufacture of soda from its sulphate, and by the intermedium of carbon (charcoal or small coal) and oxide of iron, would be, in many aspects, a great improvement upon the Leblanc process. He next mentions some experiments to illustrate his views on this subject. He took 105 parts, by weight (three atoms), of sulphate of soda; 40 parts, by weight (1 atom), of peroxide of iron; and 25 parts, by weight (eight atoms) of carbon. This mixture fused readily; treated with water, it yielded a solution which, on passing therein a current of carbonic acid gas, became quite clear, leaving only 2·79 per cent of insoluble residue. However fair the results these experiments gave on the small scale, the author is himself unable to solve a difficulty which, on the large scale, would be an absolute impediment to the action; to wit, that neither cast nor wrought-iron vessels—and, worse yet, no fire-clay crucibles, or furnaces built with fire-bricks—will stand the action which is called into play, leaving out of the question the necessity of absolute exclusion of air during the fusion.

On a Dolomitic Marl, and its Use in the Making of Cement.—L. Gatschenberger.—In the neighbourhood of Heidelberg, a marl occurs which, after being prepared for that purpose, yields a cement of the following composition, in 100 parts:—Lime, 44·22; magnesia, 17·77; peroxide of iron, 3·07; alumina, 5·75; protoxide of manganese, 2·33; soda and potassa, 4·72; silica, 22·14. The author had the opportunity of experimenting with the marl itself; and he states—"I find there are two different modes of obtaining from this marl an excellent hydraulic lime—1st, to burn the marl at a temperature below 400°, whereby the magnesia only loses its carbonic acid, while that from the lime is not expelled; 2nd, to burn the marl at a very elevated temperature, whereby the material is even somewhat fluxed. In the first instance, the magnesia is the active matter, since I have found that it hardens under water with carbonate of

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lime perfectly well, but not with caustic lime. In the second instance, the magnesia loses, indeed, its hydraulic properties, but, instead thereof, its activity towards silica is so increased as to behave therewith as lime does in such cases. The author finds that the cement obtained by the application of the very high temperature, is preferable to the ordinarily-obtained hydraulic cements. A very good cement made at high temperature contains, for 100 parts of SiO_2,R_2O_3, 304 parts CaO,MgO, whereby the proportion between lime and magnesia is as 2 to 1.

On Alkanin.—Prof. Bœttger.—The author states that M. Hirzel, at Leipzig, prepares alkanin, the extract of the alkanet root *anchusa tinctoria*, on the large scale. This extract is dissolved in absolute alcohol; and with this solution strips of Swedish filtering paper are saturated, and made use of, after drying, for detecting even the very faintest traces of ammonia. The alcoholic solution exhibits a beautiful red colour, which, even by the ammonia present in tobacco-smoke, or in illuminating gas, is instantly converted into a beautiful blue. The alcoholic solution and the test-paper have, of course, to be kept carefully excluded from all ammoniacal fumes. The red paper may be turned into blue by a very weak aqueous solution of carbonate of soda, and it then becomes an excellent test for even the faintest trace of any acid, turning red therewith at once.

Preparation of Pure Oxygen Gas at the Ordinary Temperature.—Prof. Bœttger.—The author says that, when a mixture is made of equal parts, by weight, of peroxide of lead and peroxide of barium, and there is poured on this mixture dilute nitric acid of a strength of 9° Beaumé, and specific gravity 1·067, a current of pure oxygen, free from ozone and antozone, is given off abundantly. The mixture of the two peroxides alluded to may be kept together in a stoppered bottle in dry state for any length of time.

Analysis of Palm-Nut Meal and Palm-Nut Cake.—Prof. Hohmann.—Palm-nut meal contains, in 100 parts—Water, 8·55; albumen, 19·56; fatty matters, 1·19; starch, 47·73; woody-fibre, 20·04; ash, 2·93. Palm-nut cake contains, in 190 parts—Water, 10·0; albumen, 15·1; fatty matters, 15·9; starch, 41·0; woody-fibre and ash, 18·0. These substances are obtained from the *Elaïs equienensis*, and used as fodder for cattle.

Vol. cxcii., No. 6, second number for June, 1869.

This periodical contains the following papers bearing upon chemistry, and sciences intimately allied thereto:—

Coating of Glass, Porcelain, or Earthenware with a Thin Film of Lustrous Metallic Platinum.—Prof. Bœttger.—Dry chloride of platinum, freed from excess of acid, is mixed, in a small porcelain mortar, with essential oil of rosmarine (*Oleum anthos*) until the original brown-red colour of the salt has entirely disappeared, and has been converted into a black, pitch-like looking mass. In order to effect this result, it will be necessary to renew the essential oil at least three times. When the pitch-like mass has been obtained, the oil is entirely removed, and the pasty mass is weighed, and afterwards mixed with at least five times its weight of lavender oil, and mixed therewith to a homogeneous fluid; this, after having been quietly standing for half-an-hour, is applied with a hair brush on the glass or porcelain objects to which it is desired to give a coating of lustrous platinum; and, after the very thinly and evenly laid on film is dry, the objects are either placed in a red-hot muffle, or heated in the flame of a glassblower's lamp, care being taken not to exceed a red heat.

Black Patina upon Zinc.—M. Neumann.—The author has instituted a series of researches to find out the best and most suitable material to produce upon zinc—or rather upon statuary and ornamental objects made of that metal—a pleasing blackish coating, without the necessity of impairing the effect of the natural colour of the metal, as would be the case when an oil-paint or varnish is used. The best results were obtained by the author when nitrate of protoxide of manganese was used; this salt, on being heated, is decomposed, yielding black peroxide of manganese, and the degree of heat required is not so high as to affect the zinc. To 1 litre of pure water, 54 grammes of the nitrate alluded to, and containing six equivalents of water of crystallisation, is, according to the author, the best solution for this purpose; and the specific gravity of that solution, at 14° R., is stated by the author to be 1·125.

Saponification of Fats when in the state of Emulsion.—M. Waldeck.—This paper confirms the results formerly obtained by M. Mège-Mouries. The author of this memoir points out that forming an emulsion of fats by means of substances such as gum, for instance, would be impracticable for the manufacture of soap, entailing, as it would do, loss of lye as well as of the gum or other similar substance; he, therefore, in consequence of the results obtained by him in experiments expressly instituted, advises the use of alkaline lye for the purpose of forming emulsion; but, if that plan be resorted to for soap-making purposes, the use of distilled water is an absolute requisite, but, of course, no impediment at all, since, where steam is used, distilled water is readily enough obtainable. The emulsed fats are very rapidly and readily saponified.

Portuguese Graphite.—M. Knublauch.—In 100 parts, this material was found to contain—Water (hygroscopic as well as of combination), 10·21; carbon, 38·47; ash, 50·81.

Consumption of Divers Materials used as Substances for the Production of Artificial Light.—Dr. Willigk.—This paper, although very interesting, is too lengthy to admit of useful abstraction.

On a So-Called Disinfecting Soap.—Dr. Pincus.—The author very properly calls attention to an error committed by a chemist and a soap manufacturer, who state that they have succeeded in obtaining a soap which contains permanganate of potassa as an active and disinfecting ingredient. On investigation by the author, he found, as might be expected, that even the freshly made soap only contained oxide of manganese, and a mere trace of permanganate. This latter salt, of course, cannot be kept for any length of time in contact with an organic material, as soap is, without becoming decomposed. The soap was made by incorporating into well-made, hard soap, quite dry, and cut into shreds, powdered permanganate, and then forming this mixture into a cake by strong pressure.

Annales du Génie Civil, No. 6, June, 1869.

This periodical contains a lengthy paper—

On Wine.—M. Boucherie.—Composition of must and of wine: the former contains—Sugar, a nitrogenous principle which is fit for fermentation, ferment, or active yeast, a colouring matter contained in the skin of the grape, but, as yet, not dissolved in the liquid, and oxygen and nitrogen. Wine contains carbonic acid, a small quantity of grape sugar, alcohol, amylic alcohol ($C_{10}H_{12}O_2$), butylic alcohol ($C_8H_{10}O_2$), propylic alcohol ($C_6H_8O_2$), campholic alcohol ($C_{20}H_{18}O_2$), several essential oils (the nature of which is not precisely known), oenanthic ether, aldehyde, valeric acid, acetic acid, butyric acid, glycerine, and the colouring matter of the skin of the grapes dissolved in the alcohol formed by the fermentation. Wine and must, moreover, constantly contain water, organic non-crystallisable matter, gum-like substances (as pectin and dextrin), mannite, and nitrogenous substances; and also the following crystallisable organic acids:—Tartaric, racemic, tannic, malic, pectic, and citric. No *free* mineral acids. The following salts of organic acids and inorganic bases:—Bitartrate of potassa, tartrate of lime, tartrate of alumina, malate of potassa, malate of lime, pectate of potassa, pectate of lime, divers acetates, further nitrates, phosphates, sulphates, silicates of the above-named bases, and also chlorides, iodides, bromides, and fluorides of these bases; while wine contains infinitesimal doses of soda, oxide of iron, alumina, oxide of manganese, magnesia, and ammonia. The quantity of alcohol naturally present in 100 parts of wine varies very considerably, and varies according

to the locality where it is grown, the climate during the time when it was grown, and the variety of grape from which it is obtained. For red Bordeaux wines of average good quality, the quantity of alcohol varies from 8·10 to 10·85 per cent (the author does not state whether he means by bulk or by weight). For white Bordeaux wines, it varies from 9·25 to 15 per cent on average good wine and divers brands. For Burgundy wines (red variety), the quantity of alcohol varies from 10·10 to 13·09 per cent; white variety, from 12·22 to 14·90. Good Roussillon contains about from 16·20 to 17·25 per cent of natural alcohol. White hermitage wine contains, on an average, 16·0 per cent of alcohol. Effervescing champagne contains 11·20 per cent of alcohol, while genuine port wine contains naturally from 22·50 to 23 per cent of alcohol, and marsala as much as 25·09 per cent. This alcohol, be it understood, is absolute and anhydrous.

The other papers of this periodical are devoted, as might be surmised from the title, to matters quite foreign to the subject just briefly abstracted, and of no direct interest to our readers.

Zeitschrift für Chemie, von Beilstein, No. 11, June 26, 1869.

This periodical contains the following original papers:—

Synthesis of Crotonic Acid.—M. Stacewicz.—The author says—My starting point is taken from the well-known constitution of the acrylic acid series, and this made me expect to succeed in synthetically preparing crotonic acid, according to the scheme expressed in the following formulæ—

$$C_2H_2\left\{\begin{matrix}ClO\\H\end{matrix}\right\}O+C_2H_4Cl+2Ag=C_2H_2(C_2H_3)\left\{\begin{matrix}O\\H\end{matrix}\right\}O+AgCl.$$

The experiment was crowned with success, but the acid obtained differs from that prepared from cyanide of allyl. The mixture of chloracetic acid, chloraceten, and silver is heated, in a sealed tube, up to 140°, and, after the end of the reaction, the contents of the tube are submitted to fractional distillation. At 127°, an oily fluid is obtained, soluble in water, exhibiting a feebly aromatic smell; this fluid reddens blue litmus paper, and acts, when in contact with the skin of the human body, as a blistering agent. The silver-salt of this acid, $C_4H_3AgO_2$, is difficultly soluble in water, and crystallises in dendritic groups; the formula for crotonic acid is, therefore—

$$C\left\{\begin{matrix}H\\CH_2.CH_2\\---\\O\\OH\end{matrix}\right.$$

On Chlorinated Toluidine, and a New Mode of Preparation of Bromobenzoic Acid.—M. Wroblevsky.—Chlorinated toluidine is prepared by passing through acetotoluid, $(C_2H_3O)HN.C_7H_7$, chlorine gas, whereby chloracetotoluid is obtained, which is purified by repeated recrystallisation from its solution in water. This substance, which is composed according to the formula—

$$C_6H_3Cl(CH_3).NH(C_2H_3O),$$

crystallises in large foliated crystals, fuses at 99°, is readily soluble in alcohol, less so in water; on being boiled with an alcoholic caustic potassa solution, acetic acid is formed, and chlorotoluidine—

$$C_6H_3Cl(CH_3)NH_2.$$

It is a colourless fluid, boils at 222°, is soluble in alcohol, but almost insoluble in water. From ortho-bromotoluol, a colourless liquid, which boils at 182°, the author prepared, by treating it with bichromate of potassa and sulphuric acid, ortho-bromobenzoic acid; this is a solid substance, which fuses at 153°, and then sublimes in long needle-shaped crystals, identical with those of the same compounds as obtained from benzoic acid.

On Sulphate of Lime and Potassa.—M. H. Struve.—This double salt was first discovered by M. Phillips, in the year 1850. The author of this paper says—When crystals of sulphate of lime are put into a saturated solution of sulphate of potassa at 12° (the specific gravity of that solution being 1·0716, and containing 9·41 per cent of the anhydrous sulphate of potassa), the crystals of sulphate of lime are soon converted into somewhat bulky pseudomorphic crystals of the double salt of sulphate of lime and potassa. When the solution of sulphate of potassa is more dilute, the change takes place more slowly; and when, in 100 c.c. of water, only 2·365 grms. of sulphate of potassa are dissolved, the sulphate of lime is simply dissolved therein without forming a double salt; burnt gypsum and native anhydrite behave in the same manner. The formation of similar double-salts takes place, but more slowly, when sulphate of lime is put into concentrated solutions of the chloride, bromide, and iodide of potassium; the same takes place with solution of nitrate of potassa.

New Mode of Formation of Anhydrite.—M. Struve. — 100 parts of sulphuric acid (sp. gr. 1·82) dissolve, at ordinary temperature, 1·992 parts of artificial anhydrite (anhydrous sulphate of lime) and 1·953 parts of native anhydrite. When, to a quantity of 4 grms. of crystallised gypsum, were added 135 grms. of the same sulphuric acid, a solution was obtained which contains, for 100 parts of acid, 1·059 parts of $CaOSO_3$. When the solution of $CaO.SO_3$ in SO_3HO is diluted with its own weight of water, a complete precipitation of gypsum took place after a time; no lime could be detected in the filtrate.

Preliminary Notices.—M. Wislicenus.—This paper treats briefly—

On Sulphacetone, and on the Conversion of β Oxybutyric Acid into Crotonic Acid.—As, however the author states that his researches are as yet incomplete, and will be treated more fully hereafter, we abstain at present from further notice of them.

Researches on Piperinic Acid.—MM. Fittig and Mielck.—This is a lengthy memoir, chiefly treating on the products of oxidation of piperinic acid, which, when acted upon by permanganate of potassa in aqueous solution, yields a cystalline substance (formula, $C_8H_6O_3$), which body the authors called *piperonal*. It is difficultly soluble in cold water, more readily in boiling water, and very soluble in alcohol; it is in every way soluble in the latter fluid and in ether at the boiling temperature of these fluids. Piperonal fuses at 37°, and boils, without decomposition, at 263°. Piperonylic acid, $C_8H_6O_4$, is obtained in small quantity, simultaneously with the last-named substance, during the action of permanganate of potassa; moreover, piperonylic acid is readily obtained from piperonal by the action of permangenate. The acid just alluded to is a solid substance, crystalline, soluble in water and alcohol, fusing at 227·5°, subliming already below its point of fusion; it is a monobasic acid. Nitric acid acts most energetically upon piperinic acid, even when the former is dilute; the result of this reaction is the formation of an amorphous reddish-coloured substance, which baffled the efforts of the authors in obtaining reliable analytical results. After having, at great length, described the bromine reaction upon piperinic acid, the authors state that their researches are not as yet sufficiently complete to enable them to speak with confidence about some of their results.

Synthesis of Acids Homologous with Cinnamic Acid.—MM. Fittig and Bieber.—According to M. Bertagni's statement, cinnamic acid is formed when oil of bitter almonds is heated with chloride of acetyl; relying on this fully borne out statement the authors thought that when, instead of acetylchloride, homologous chlorides were taken, homologues of cinnamic acid would be formed; this idea has been experimentally tested, and the authors met with correct results; when equal equivalents of oil of bitter almonds and butyryl chloride are mixed and heated in sealed tubes, first to 100°, the reaction takes place, but only slowly; at from 130° to 140°, the reaction is more rapid, but yet takes several days for its completion; an acid was obtained of the formula, $C_{11}H_{12}O_2$, which the authors have

named phenylangelic acid, because it stands in the same relation to cinnamic acid as angelic acid stands to acrylic acid; the quantity of acid obtained in this reaction is very small, the greater portion of the oil of bitter almonds being converted into a blackish resin, insoluble in solution of carbonate of soda.]

On Ethyl-Phenol.—MM. Fittig and Kiesow.—Ethyl-phenol is prepared in pure state from ethyl benzol sulphate of potassium, which is submitted to distillation at from 270° to 280°, after having been mixed with thrice its weight of hydrate of potassa; the purification of the raw product thus obtained is a slow and tedious process; at length a solid substance, partaking of a regular crystalline form and fusing at about 48°, is obtained; this body is the ethyl-phenol—

$$C_8H_{10}O=C_6H_4\begin{cases}C_2H_5\\HO\end{cases}$$

it boils at 210°, but volatilises even at ordinary temperature.

On Amido-Benzoic and Nitrophtalic Acids.—M. Faust.—When nitrophtalic acid is reduced by means of tin and hydrochloric acid, amido-benzoic acid is formed, which is in every respect identical with amido-benzoic acid obtained by other means; it is a crystalline solid, containing, in 100 parts, C, 61·3; H, 5·1; O, 34·6. The author says he desires to rectify a statement made in a former number of this periodical, wherein he described as an ether what has afterwards been ascertained to be nitrophtalic acid—$C_6H_3(NO_2)O_4.C_2H_5.H$.

Conversion of Aldehyde into Aceton.—M. Schloemilch.—The author states, as a preliminary notice, *pour prendre date*, "I have succeeded in doing what is indicated under this heading, but am as yet occupied with further researches on this subject." This observation also extends to the contents of the brief notices of the following subjects:—

On Lepides and Oxylepides.—M. Limpricht.

On the Bromo-Substitution Products of Dibenzyl.—Same author.

Synthesis of Anhydrous Lactic Acid.—Dr. Von der Brüggen.—The author says, when anhydrous lactic acid is considered as being an ether, it follows that it must be possible to obtain this acid by the action of bromo-propionic acid on lactate of potassa; this, the author states, he has actually carried out experimentally. His paper, however interesting, is so filled with formulæ, exhibited somewhat in the style of genealogical tables, that it would take up more room than we can afford, and therefore content ourselves with announcing in this brief notice the scientific *fait accompli*.

Preparation of Oxalate of Acetonin.—M. E. Mulder.—Aceton is added to sulpho-carbaminate of ammonium; the crude sulpho-carbaminate of acetonin thus obtained is washed with alcohol of 90 per cent, next dissolved in water, precipitated by means of perchloride of mercury, filtered; H_2S is passed through the filtrate; the latter is evaporated to dryness on a water-bath, the residue treated with absolute alcohol (which leaves $ClNH_4$ undissolved, and keeps hydrochlorate of acetonin in solution); water is next added, then again evaporated to dryness, the residue treated with $C_2O_4Ag_2$ in excess, filtered, the filtrate again evaporated to dryness, and afterwards exhausted with absolute alcohol until nothing more is dissolved; the oxalate of acetonin deposits from the solution and is purified by re-crystallisation; it exhibits a beautifully crystalline mass. Formula—

$$C_2O_2.C_9H_{20}N_2O_2+2H_2O.$$

The following are only preliminary notices on the respective subjects, of which more full research is going on:—

Kreatin and Aldehyde.—MM. Mulder and Moutheran.

Action of Bromine on Butyrate and Valerianate of Silver.—M. Borodin.

Isomers of Valerianic Acid.—Dr. Schneider.—The *remainder* and smallest portion of this number is, as usual, devoted to abstracts from divers papers, *Comptes Rendus*, &c., which are chiefly of last year's date, and already noticed by us.

No. 12, June 30, 1869.

This number does not contain any original papers at all, but we find in it some communications taken from a paper or periodical published in Switzerland, but, as stated, only printed for private circulation among the members of a society for the diffusion of useful knowledge, established at Zürich. The first of these papers is on the

Solutions of Iodine in Water and Aqueous Solution of Iodide of Potassium.—Messrs. Dossios and Weith.—The authors prepared, in the first place, perfectly pure distilled water, and employed pure iodine, free from chlorine, which they dissolved in the water, and which they ascertained to be, by means of volumetrical estimation with hyposulphite of soda, 0·01519173 grm. of iodine in 1000 c.c. of water. They found this quantity of dissolved iodine increased already after two days, and gradually increasing more and more, so much so that, about three months after having been first made, the solution contained nearly twice as much iodine. The authors ascertained the presence of hydriodic acid, conclusively proving that decomposition of water takes place. The authors also instituted a series of experiments to ascertain whether solutions of iodine in aqueous solutions of iodide of potassium are chemical combinations, or simply mixtures. The result of their experiments is not favourable to the idea that these solutions should be chemical combinations, since it is readily possible to withdraw the iodine from these solutions, not only by simple solvents of iodine, but even by the passing through of a current of air. From some quantitative experiments made with perfectly pure materials, it appears that, at a temperature of 7·9°, and with solutions wherein the quantity of iodide of potassium varies from 1·802 to 12·643 per cent, the quantity of pure iodine thereby dissolved ranges from 1·173 to 12·060 per cent.

Combinations of Ammonia with Cyanide of Silver and Sulphocyanide of Silver.—M. Weith.—The author says that, when cyanides in solution are treated with ammoniacal solution of silver, a crystalline compound of cyanide of silver and ammonia, $CNAgNH_3$, is obtained, which, either on exposure to dry air, or by being placed in water, loses the ammonia; but this compound is, after all, the author states, a true combination, and not a mixture. Sulphocyanide of silver and ammonium, $CNS.Ag.NH_3$, is obtained when sulphide of silver is dissolved in warm and concentrated ammonia. It is a crystalline solid body, which is readily decomposed on exposure to the air, but which may be heated up to 200° when surrounded by ammonia solution.

Behaviour of some Double Cyanides towards Ammoniacal Solution of Silver.—M. Weith.—With the view of separating the cyanogen from ferrocyanide of silver by means of peroxide of mercury, according to a plan published by Prof. Rose, the author of this paper found that this decomposition only takes place very incompletely and slowly. The same was observed when it was tried to decompose the aforesaid ferrocyanide by means of hydrate of potassa. The decomposition is, however, very readily and completely effected by boiling the ferrocyanide of silver with liquid ammonia; in that instance, the iron is separated as oxide; while the solution contains cyanide of silver and cyanide of ammonium—

$$Cy_6FeAg_4+2NH_3+H_2O=FeO+4AgCy+2NH_4Cy.$$

The author calls attention to the fact that it is stated that ferrocyanide of silver is insoluble in liquid ammonia. This is right to a certain extent; but even in the cold, and more so on being gently heated, this fluid will exhibit, after filtration, and on addition of a few drops of dilute sulphuric acid, a more or less copious precipitate of cyanide of silver. When ferrocyanide of silver is mixed with an ammoniacal solution of nitrate of silver, instead of with ammonia only, and heat is applied, the iron is separated as oxide; while from this

solution the whole quantity of cyanogen may be separated, on addition of a few drops of dilute nitric acid, as cyanide of silver. Ammoniacal solution of nitrate of silver behaves with ferro- and ferricyanides of potassium, with ferrocyanide of iron (Berlin blue), and other similar compounds (cobalticyanide of potassium inclusive), in a similar manner. Ferrocyanide of copper, however, cannot be treated in this manner, since the presence of copper gives rise to separation of silver in the metallic state.

The subject matter of all the other papers contained in this number has been treated in our columns already.

Journal de Pharmacie et de Chimie, June, 1869.

This periodical contains the following original papers:—

Researches on Protoxide of Nitrogen in Solution.—M. S. Limonsin.—The author says that the great solubility of this gas in water, especially if its temperature is rather low, induced him to try what the physiological effects of such a solution would be upon men (the author himself) and upon animals. With the main portion of his paper (being, strickly speaking, a chemico-physiologico experimental essay) we will not occupy ourselves. The solution of the protoxide of nitrogen in cold water, and obtained under ordinary pressure of the atmosphere, tastes sweetish, and decidedly saccharine, if, by means of pressure, water has been made to absorb a large bulk of this gas; as might be expected, this solution is readily decomposed by substances capable of taking up oxygen. The main point of importance in this paper is the anæsthetic action of the gas and solution alluded to.

Action of Chloroform upon Frommherz's Fluid.—M. Beaudrimont.—Frommherz's fluid is the *cupro-potassic tartrate*. The author's paper contains the results of some experiments made with the view to prove that, when even a very small quantity of chloroform—for instance, two drops—are mixed with 100 c.c. of water, and there is added thereto a small quantity of the double tartrate of potassa and copper, reduction of the latter takes place almost instantaneously when gentle heat is applied. The author has based upon this property a volumetrical method for the estimation of chloroform; and, notwithstanding the great volatility of that fluid somewhat interferes, the author has succeeded in his object. One equivalent of chloroform (119·5) reduces four equivalents of copper; 10 c.c. of Frommherz's liquid, containing 0·15 grm. of metallic copper, required 12 c.c. of a solution of chloroform, containing 1·195 grms. of chloroform, for 100 c.c.; while of a solution of chloroform of twice the strength just stated—to wit, containing 2·39 grms. for 100 c.c.—just 6 c.c. were required.

Arsenical Aniline Reds—Aniline Red of M. Coupier prepared without Arsenic.—M. Roussin.—This being rather a practical receipt than a scientific memoir is not well suitable for abstraction.

The remainder of this periodical is filled partly with abstracts from the *Comptes Rendus*, already noticed by us, and partly with papers relating to toxicology and *materia medica*.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 2, July 12, 1869.

This number opens with a brief notice of the death of Prof. Bérard, at Montpellier, already recorded in our paper; but we meet here with the following particulars, which are of general interest:—The father of the deceased was associated with the celebrated Chaptal, in the business of an extensive chemical factory, yet in existence near Montpellier, where the manufacture of sulphuric acid was first started on the continuous principle, and whereby has been effected the cheap production of that acid, and, by its means, of almost all chemicals. The deceased Dean of the medical faculty established in the city just alluded to, had been, since 1819, one of the corresponding members of the scientific body which now is the Académie des Sciences, but which in 1819 was l'Académie, an institution of very ancient date. A very great portion of this number is again devoted to the rather barren controversy about some letters and papers, purporting to be written by men who died some 150 years ago at the least. Among the papers and communications, we notice:—

Researches on the Products of the Alcoholic Fermentation of Beet-Root Juice.—MM. Pierre and Puchot.—The authors state that they have obtained from that juice, after alcoholic fermentation—(1) vinic aldehyde, ready formed; (2) vinic alcohol; (3) propylic alcohol; (4) butylic alcohol; (5) amylic alcohol. The authors devote this paper more especially to the study of the propylic alcohol, which they say boils, in its normal state, at 98°, while its sp. gr. at 0° is 0·820; its volume at 0° being taken as equal to 1000, it becomes 1115 at 98°, at which temperature its sp. gr. is 0·735. The authors further state that, theoretically speaking, propylic alcohol can be directly formed from sugar, by simply fixation of water and elimination of carbonic acid.

New Researches on the Properties of Explosive Compounds.—Mr. Abel.—The contents of this abstract, which is published in this number at the express desire of the members of the Institute, are already well known to our readers.

Compressibility of Gases at High Temperatures.—M. Blaserna.—The author first refers in this paper to a series of researches made by him on this subject in former years, and published by him in the *Annales de Chimie et de Physique*. He next calls attention to a series of researches on this very same subject recently made by M. Amagat, which confirm both the author's researches and those made long ago by M. Victor Regnault. The author next passes to researches on the motion of gases, which, however, is a mathematico-physical paper, and not suitable for condensation in our columns.

Researches on Sulphur.—M. Chevrier.—The author has studied the action of vapour of sulphur on oxygen, hydrogen, nitrogen, protoxide and deutoxide of nitrogen, carbonic oxide, and carbonic acid. Vapour of sulphur and oxygen gas form a slightly explosive mixture under some conditions, but usually the vapour of sulphur burns off quietly, forming sulphurous acid. Hydrogen and vapour of sulphur yield sulphuretted hydrogen gas very readily and abundantly! With vapour of sulphur and nitrogen the author found no action at all. Vapour of sulphur and the two oxides of nitrogen just alluded to form, in the first place, sulphurous acid; nitrogen is set free, and if a frigorific mixture be applied to the apparatus containing the mixed gases and vapours, large so-called lead-chamber crystals are obtained. Oxide of carbon yields, with vapour of sulphur, oxysulphide of carbon. Carbonic acid and vapour of sulphur, exposed to the discharges of electric sparks, yield oxysulphide of carbon and sulphurous acid. The author of this paper adds a short notice on an—

Improvement of the Preparation of Carbonic Oxide.—When the gas just alluded to is evolved from a mixture of oxalic and sulphuric acids, as is well known, a mixture of carbonic acid and carbonic oxide gases is obtained. This mixture of gases the author causes to pass through a tube made red-hot in a suitable furnace and filled with charcoal previously well re-burnt; and, after having washed the gas through a solution of potassa, and also lime-water, he thus obtains a bulk of the pure carbonic oxide gas three times larger than would be the case if the carbonic acid simultaneously formed were not decomposed by the red-hot charcoal, which must be free from yielding any carburetted hydrogen gases.

No. 3, July 19, 1869.

This number contains the following papers, the contents o which belong to chemistry and sciences allied therewith:—

Explosive Properties of Chloride of Nitrogen and its Propulsive Force.—MM. St. Claire-Deville and P. Hautefeuille.—Chloride of nitrogen was discovered in the year 1812, by M. Dulong; it is the most unstable com-

pound we are acquainted with, exploding most violently by very slight causes. The authors have, however, succeeded —and recorded in this memoir the means applied for this purpose—to estimate and measure with accuracy the force exerted by this substance when it changes its liquid for a gaseous state of aggregation. This they have effected by estimating exactly the quantity of caloric units which are set free at the moment of the explosion of the chloride of nitrogen; this quantity amounts to 38,700. The temperature of the gases, when the explosion takes place in closed vessels, amounts to 2128°, and the pressure of the gases is then equal to 3500 atmospheres, or equal to a pressure of 52,500 English lbs. to the square inch.

Spectrum Observations of Small Stars.—Rev. Father Secchi, S. J.—In a letter dated from Rome, July 13th, the eminent astronomer states that he has succeeded in studying the spectra of stars which are only of the 8th and 9th magnitude. The light emitted by such stars being very feeble, it is gratifying to learn that observation has proved that, among the spectral lines, those of carbon occur, and that the spectra, as seen, appear to prove a common origin for these small stars which are, comparatively, situated near to each other.

On Jacobsite, a New Mineral.—M. A. Damour.—This mineral owes its name to the fact that it has been found at Jakobsburg, in Nordmark, province of Wermland, Sweden. It exhibits regular octahedral crystalline shape; its colour is dark, with a metallic lustre; when pulverised, its colour is blackish brown; it scratches glass; its sp. gr. is 4·75 at 16°; it is attracted by the magnetic needle; is infusible before blowpipe flame, and loses no weight when strongly ignited in a platinum crucible; fuses readily to a bead with borax and phosphor-salt, yielding a yellowish green coloured glass; is insoluble in nitric acid, but slowly, yet completely dissolved by hydrochloric acid, while, at the same time, chlorine gas is given off. This mineral consists, in 100 parts, of:—Peroxide of iron, 68·25; protoxide of manganese, 20·57; peroxide of manganese, 4·21; magnesia, 6·41; and traces of oxide of zinc.

New Process for Obtaining Iron from its Ores.—M. Ponsard.—The author of this paper has applied Siemen's furnace to the manufacture of iron; he states that he has succeeded in producing 1 ton of cast-iron of excellent quality with a consumption of only 1 ton of fuel. The author summarises his results in the following manner:—(1) A great saving of fuel can be made, and iron obtained from its ores, without the use of blast furnace; (2) that, since the heat produced by flame is sufficient to effect all the chemical reactions and melt the metal, there may be used all kinds of fuel which produce gas—that is to say, all kinds of coal, no matter whatever their quality, wood, lignite, peat, hydrogen gas, and mineral oils; (3) it is possible to obtain, at will, a more or less carburetted metal, according to the quantity of carbonaceous matter which is mixed with the ore and placed in the crucibles to act as chemical agent only. Specimens of iron of very good quality, obtained by the process as carried on by the author, were exhibited to the members of the Academy at this meeting.

Magnetic Oxide of Iron and its Salts.—M. Lefort.—The author first reviews some experiments made by him on this subject so far back as the year 1852; he next states that, as a result from these researches, he had found that it was possible to obtain perfectly soluble and well-crystallised salts, which prove that the so-called magnetic oxide of iron (proto-sesqui-oxide) is capable of forming salts. The author prepares the proto-sesqui-oxide by precipitating, by means of caustic potassa, a solution containing a ferrous-ferric salt. The reason why preference is given to potassa is, that an oxide is obtained which is less readily affected by air, and more stable. This oxide, $FeO + Fe_2O_3 + HO$, yields, after having dissolved in hydrochloric acid, and on being left to crystallise while standing over sulphuric acid, a crystalline mass made up according to the formula—

$$ClFe + Cl_3Fe_2 + 18HO.$$

The author has also obtained a sulphate of the following composition:—

$$SO_3FeO + 3(SO_3),Fe_2O_3 + 2SO_3 + 15HO;$$

this salt, and in fact all the salts the magnetic oxide is capable of forming, are decomposed by heat far below the boiling-point of water.

Electricity.—M. Tourdes.—This is a short paper on a curious case of death by lightning, which took place on the 13th inst., at Kehl Bridge, near Strasbourg. The curious point is, that while quite close to the spot where three soldiers were seated under a rather low chestnut tree, two of whom were killed, while the third was rendered insensible and temporarily partly paralysed, there is a building provided with lightning conductors, and near, also, a very large iron railway bridge; yet the tree was struck, and the men seated under it on a bench killed, notwithstanding large masses of metal and excellent conductors of electricity were, at a far greater elevation, at hand for the electric fluid to run along. The author's opinion is that the metal buttons, and other ornaments made of metal, on the soldiers' dresses were the cause of their death by lightning.

New Acid from Sulphur.—M. Schützenberger.—While at a future date we may give a fuller account of the interesting facts contained in this rather lengthy memoir, we now confine ourselves to stating that the author has succeeded in forming a compound made up of a double atom of sulphurous acid, wherin 1 atom of oxygen is replaced by 1 atom of hydrogen; this free and anhydrous acid should be represented by S_2O_3H. The author has proposed to name this substance hydrosulphurous acid; some of its salts have been prepared by the author and obtained in crystalline state; the free acid is a very unstable compound, exerting strong reducing action.

Crystallisation of Metallic Oxides.—M. Sidot.—In this paper, the author records a series of experiments made by him in order to obtain artificially crystallised metallic oxides, starting from the well-known fact that most native oxides and sulphurets exhibit a crystalline form. The author has been occupied in researches with the view to obtain these forms by artificial means, and has succeeded, in many instances, by simply submitting some oxides—for instance, the peroxide of iron—to long-continued and strong heat. By this means, the said peroxide loses a portion of its oxygen, magnetic oxide is formed and simultaneously obtained in a crystalline shape; the sesquioxide of manganese, the oxides of cadmium and zinc, have also been obtained in distinctly crystalline state, by various manipulations and the application of suitable very high degrees of temperature.

Acetic Fermentation of Methylic Alcohol.—M. Béchamp.—The author states that on the 5th of September, 1868, he introduced into a vessel which could be properly closed, a mixture of methylic alcohol, pulp of sheep's liver, chalk, and water; and on the 15th of June last, he opened the vessel and proceeded to test its contents, which he found to consist chiefly of acetic acid and non-decomposed methylic alcohol. His object was to ascertain whether methylic alcohol yields, under these conditions, any higher oxidised compound than acetic acid, which is ascertained to be the ultimate term of oxidation under the influence of the ferments used.

Journal für Praktische Chemie, No. 8, 1869.

This paper contains the following original papers and essays:—

Isomerism of the Derivatives from Naphthaline.—M. L. Schæffer.—This paper treats on naphthols, C_{10},

$H_7.OH$, distinguishing—α naphthol, $C_{10}H_8O$; β naphthol; naphtholates; naphtholethyl ether, $C_{10}H_7OC_2H_5$; distinguished again into α and β. The paper is written with the view of proving that the isomerism of each class of bodies derived from naphthaline is a persistent character thereof; the paper is, however, too lengthy for further condensation.

Protein compounds met with in Zea-Maize, Indian Corn.—M. Ritthausen.—The author first reviews the labours of MM. Gorham, Bizio, Berzelius, and Stepf on this subject; and next states that he applied, for his researches, several varieties of maise grown in the botanic garden of Bonn University, at Poppelsdorf. The author obtained a substance which he names fibrine of Indian corn, and which contains, in 100 parts:—C, 54·66; H, 7·45; N, 15·50; S, 0·69; O, 21·70. This substance is insoluble in water, and soluble in alcohol and very weak alkaline solutions.

Alloy of Zinc and Iron.—M. Bayer.—The material here described was accidentally obtained in a Belgian iron smelting works, among a job lot of old iron. The alloy was of a very bright metallic and crystalline appearance, very brittle, so that it could be readily reduced to powder; sp. gr., 7·485; nearly entirely soluble, without residue, in dilute sulphuric and hydrochloric acids. Composition, in 100 parts:—Zinc, 83·66; iron, 13·00; lead, 2·70; tin, 0·06; insoluble residue, carbonaceous matter, 0·20.

No. 9, 1869.

This number opens with a list of the—

Symbols and Equivalents of the Elements.

And further contains the following original papers:—

On a Double Sulphide of Iron and Potassium.—M. Preis.—In order to obtain this compound, five parts, by weight, of iron, five parts of carbonate of potassa, and one part of iron (in the state of *ferrum redactum hydrogenio*) are intimately mixed, and placed in a crucible, and submitted to a gradually-increasing heat, and kept for at least one hour at a bright red heat. The substance thus obtained is a compound, containing, on an average, in 100 parts:—Sulphur, 39·90; iron, 35·34; potassium, 24·16. Empirical formula, KFe_2S_4; rational formula, $KS.Fe_2S_3$.

Protein Compounds contained in Oats.—Dr. Kreusler.—After reviewing the labours of Messrs. Johnston, Norton, von Bibra, and others, on this subject, the author states that he found that alcohol of ordinary strength (80 per cent) extracted the protein compounds from coarsely-ground oat-meal completely. After purifying the substance so obtained, its composition, on submitting it to elementary analysis, was found to be, in 100 parts:—C, 52·59; H, 7·65; N, 17·71; S, 1·66; O, 20·39.

The remainder of the papers are not original, and have been already abstracted by us from the original sources from which they are taken.

Les Mondes, July 15, 1869.

Although the brief notice of the following subject does not exactly belong to the subject matter usually treated in our pages, we cannot refrain from noticing the—

Steam Boiler Furnace.—Invented by M. de Pindray.—The reverend and learned editor of this periodical devotes two pages to this very interesting subject, from which we abstract the following:—Two steam boilers, of the same size, and in every respect identical to each other, were fitted up—one upon M. de Pindray's plan, the other upon the system hitherto considered the best in France—and both submitted, under precisely identical conditions, to a trial, the fuel used being the Friokaisin coal, from the neighbourhood of Charleroy, Belgium. During the trial, which lasted fully four hours, the production of steam by the Pindray system amounted to 9·440 kilos. of steam for every kilo. of coal burned; by the other system, it amounted to a production of 8·001 kilos. of steam for every kilo. of coal consumed. The indicated horse-power was (the pressure on each boiler being rigorously kept up to 4½ atmospheres) for the Pindray boiler, 124; for the other, 81. The production of steam for every square metre of heating surface amounted, in the case of the Pindray system, to 40·460 kilos., in the other case to 28·530 kilos. While the boiler fitted up to compete with M. Pindray's system of fitting up was confessedly the best, yet the latter gained 16 per cent of economy of fuel, and 42 per cent more effective force. These few data may suffice here; a saving of fuel, and a better application of heat for the purposes of production of steam are of so manifestly great interest, that we think we need not apologise for thus briefly entering for a moment on the domain of steam-boiler and furnace engineering.

July 22, 1869.

We notice from this number the following subjects:—

Wood Engraving by means of an Acid Composition.—M. Dulaurier.—The author states that, by some observations made by him previously, he was induced to try a mixture composed of sulphuric acid, several chromates, and persulphate of iron, to bite away some portions of wood upon which, after having first covered its surface with an asphalte varnish, which protects from the action of the acid composition those parts from which this varnish is not afterwards removed by an engraver's tool, he had engraved his name. This experiment, the author states, succeeded so well that very shortly wood engraving may become a greatly-improved manipulation, by means of the assistance of the biting action of acids. Unfortunately, the author neither states what kind of wood he used, nor also the precise composition of the acid mixture he has applied.

From the *accuse's de réception* of this periodical, we learn that the fifth part of the third volume of the *Archives Néerlandaises des Sciences Exactes et Naturelles*, by Dr. E. H. von Baumhauer, contains:—

Chemical Researches on the Poisonous Principle of the Root of the Cicuta Virosa.—M. Van Ankum.—This principle is an essential oil belonging to the camphine series, and is composed according to the formula $C_{10}H_{18}$; it exhibits rotatory power to the right. The root does not, according to this author, contain any alkaloid at all, either fixed or volatile.

Improved Stove and Chimney.—M. Ch. Joly.—The author states that, as a rule, the millions of chimneys applied in dwelling-houses are so badly constructed that, at the least, the useful calorific effect of the fuel is only from 5 to 10 per cent. In Paris alone, 500.000 cubic metres of wood are annually burnt, exclusive of coke and coals consumed for domestic purposes. The author has invented a combination of stove and chimney well worthy of imitation, and brought into use everywhere. His invention is based on sound principles; but, unless we reproduce the woodcuts annexed to the original, we could not make this matter well understood.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1641. J. Wilson, Royal Exchange Buildings, London, "Improvements in the manufacture of wrought iron."—A communication from I. O. York, New York, U.S.A.—Petition recorded May 28, 1869.

1713. I. Hopkinson, Leeds, "Improvements in the manufacture of artificial fuel."

1717. F. Rave, Manchester, "An improved method of extracting colour from vegetable matter."

1719. W. V. Morgan, Cannon Street, London, "Improvements in the manufacture of crucibles and other refractory articles or vessels."—A communication from J. L. Hall, and J. V. Morgan, Montreal, Canada.

1721. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improve-

ments in the manufacture of iron."—A communication from J. Burt, Detroit, Michigan, U.S.A.—June 3, 1869.

1731. J. Duke, Mannamead, near Plymouth, "Improvements in the manufacture of plaster and cement."—June 4, 1869.

1742. T. W. Arkle, Liverpool. "Improvements in the mode and means for extracting, recovering, or collecting copper from water containing the same in solution, and in apparatus therefor."—June 5, 1869.

1782. A. St. C. Radisson, Lyons, France, "Improvements in the treatment of oleine and other fatty matters for the purpose of transforming them into solid materials suitable for the manufacture of candles."

1785. W. L. Wise, Adelphi, Westminster, "Improvements in the manufacture of artificial fuel and in apparatus for the purpose."—A communication from B. Le Queune and Dumontier, St. Servan, France. June 9, 1869.

1800. G. W. Oliver, Liverpool, "Improvements in the manufacture of explosive powder and in machinery to be used in such manufacture."—A communication from P. A. Oliver, New York, U.S.A.—June 10, 1869.

1817. K. Brown, Glasgow, N.B., "Improvements in the manufacture of iron."—Petition recorded, June 14, 1869.

1832. W. Smith, Bathgate, Linlithgow, N.B., "Improvements in heating or purifying mineral oils."—June 18, 1869.

1855. T. Routledge, Ford Works, near Sunderland, "Improvements in the preparation of materials for the manufacture of paper."—June 16, 1869.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

1850. G. W. Fox, Manchester, "Improvements in the treatment of castor, cod-liver, and other medicinal oils, in order to render the same more palatable."—Petition recorded June 16, 1869.

1868. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for preparing sulphates, and obtaining fine silver therefrom."—A communication from F. Gutzkow, San Francisco, California, U.S.A.—June 17, 1869.

1884. H. A. Bonneville, Chaussée d'Antin, Paris, "Compounding and applying certain compounds, to render fabrics water repellent."—A communication from R. O. Lowry, Salem, Washington, N.Y., U.S.A.,—June 19, 1868.

NOTICES TO PROCEED.

319. W. A. Smith, Manchester, "Improvements in the preservation of meat, fish, and other perishable articles of food during their carriage by railway, and in apparatus connected therewith."—Petition recorded February 2, 1869.

374. H. A. Bonneville, Chaussée d'Antin, Paris, "A new and improved compound for preparing jelly broth."—A communication from C. J. Desnoix, Paris.—February 6, 1869.

420. J. Clayton, Radcliffe, Lancashire, "An improved paste for fixing and brightening aniline and pigment colours in printing on cotton, woollen, silk, or mixed fabrics."—February 10, 1869.

442. W. E. Newton, Chancery Lane, "Improvements in the manufacture of explosive compounds."—A communication from A. Nobel, Paris.—February 12, 1869.

637. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or purifying oils and fats."—March 2, 1869.

942. E. Morewood, Rock Cottage, Briton Ferry, Glamorganshire, "Improvements in coating metals."—March 29, 1869

1317. A. Meredith, Newgate Street, London, "Improvements in the manufacture of iron and steel."—April 28, 1869.

1469. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or treating oils and fats, and in apparatus therefor."—May 13, 1869.

1539. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for obtaining gelatine and other products from animal substances."—A communication from D. K. Tuttle, O. Lingo, W. J. Hooper, and T. Hooper, Baltimore, Ma., U.S.A.—May 19, 1869.

1575. C. W. Siemens, Great George Street, Westminster, "Improvements in calcining and smelting ores, and in furnaces and apparatus employed in connection therewith, which furnaces are also applicable to other purposes."—May 21, 1869.

1642. J. Bromer and H. Gurzkow, Frankfort-on-the-Maine, "An improved method of obtaining the anthracen out of asphaltos, that is to say, pitch produced from coal tar, and of preparing two colouring matters from the anthracen."—May 28, 1869.

426. G. F. Ansell, Bernard Street, Russell Square, Middlesex, "Improvements in the manufacture of steel and iron."—Petition recorded February 11, 1869.

434. H. Edwards, Staple Inn, Holborn, Middlesex, "An improved preserved food."—February 12, 1869.

469. L. N. Legras, Wardour Street, Middlesex, "Improvements in the preservation and disinfection of animal and other substances, and in the apparatus employed therein."

477. F. Walton, Staines, Middlesex, "Improvements in the manufacture of artificial leather."—February 16, 1869.

540. W. Ibotson, New Inn, Strand, London, W. W. Ladelle, Wraysbury, Bucks, and A. G. Southby, Bulford House, near Amesbury, Wilts, "An improved method of, and apparatus for, preparing esparto, straw, rags, or other materials for the manufacture of paper."—February 22, 1869.

781. J. Thomlinson, Carlisle, Cumberland, and W. Thomlinson, Loughborough, Leicestershire, "Improvements in the manufacture of paper and textile fabrics, and in the preparation of gypsum, to be used in such and other manufactures."—March 13, 1869.

836. J. Thomas, Middlesborough-on-Tees, W. Bacon, Newcastle-upon-Tyne, and H. Groves, Redcar, Yorkshire, "Improvements in the manufacture of iron and steel, and in furnaces and apparatus employed therein."—March 19, 1869.

1202. L. Goetz, Leith, N.B., "An improved preparation of materials for cleansing wool, cotton, linen, and other like fibrous substances."—A communication from G. Müller, Neustadt-on-the-Haardt, Bavaria—April 20, 1869.

1721. J. H. Johnson, Lincoln's Inn Fields, Middlesex. "Improvements in the manufacture of iron."—A communication from J. Burt, Detroit, Michigan, U.S.A.—June 3, 1869.

1800. G. W. Oliver, Liverpool. "Improvements in the manufacture of explosive powder, and in machinery to be used in such manufacture."—A communication from P. A. Oliver, New York, U.S.A.—June 10, 1869.

NOTES AND QUERIES.

Isinglass.—Can any of your correspondents inform me of any method of obtaining isinglass, by mixture or otherwise, in the form of a powder.—ICTHYOC.

Crystallisation of Supersaturated Solutions.—Will any of your courteous readers kindly furnish an enquirer, who is greatly interested in the subject, with a list of the bodies which are found to act as nuclei in determining the crystallisation of supersaturated solutions?—R. C. C.

Water Analysis.—I have just finished examining a spring well in the country, and found on evaporating one imperial gallon of the water to perfect dryness, the residue weighed 102 grains, and afterwards ignited and lost by ignition 40 grains. Besides, I found there exists 10 grains N_2O_5 in one gallon. Now I should like to know if it is the rule to deduct the whole, or only a part of this nitric acid, from the loss by ignition when drawing up a report, or how should I act?—J. WALLACE.

Powdering Isinglass.—Isinglass, owing to its toughness, is a substance which it is almost impossible to reduce to powder by means of pestle and mortar; but, akin to horn, to cork, and such like substances, it may be obtained in pulverulent shape by means of a sharp, well-hardened, but not too coarse file. Lump isinglass answers best for this purpose.

Pattinson's Method for Extracting Magnesia from Limestone Rocks.—Would any correspondent obligingly give me the process of extracting magnesia from the limestone rocks containing that earth, by Pattinson's method; it appears to be accomplished by carbonic acid.—W. R.

Testing Acetic Acid.—Can any of your correspondents oblige me by giving through your columns the readiest means of testing the purity and strength of acetic acid.—A. A.

Pattinson's Method for Extracting Magnesia from Magnesian Limestone.—The magnesian limestone is calcined at a dull red heat for some time. By this process the carbonic acid is expelled from the carbonate of magnesia only, but not from the carbonate of lime, which thus remains insoluble. The calcined mass is next reduced to a milk, with water, in a suitable cistern, and the carbonic acid resulting from its own calcination forced into it under powerful pressure. The result is a saturated solution of magnesia, the lime remaining unacted on so long as the magnesia is in excess. The solution, by evaporation, yields heavy carbonate, whilst carbonic acid gas is expelled and may be again used in the same manufacture. Our correspondent should bear in mind that only magnesian limestone can be thus operated upon.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS *give notice that in accordance with a suggestion of* MR. CROOKES, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* MR. CROOKES *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Biography of Dumas.—Dr. Muspratt informs us that his Biography of J. B. Dumas, M.D., was published in the *Lancet* in 1851, vol. 1, p. 248.

F. Caut.—This correspondent wishes to know what public institutions there are for the study of chemistry in Nottingham. Perhaps some of our correspondents can give the desired information.

Communications have been received from Dr. Wood; Mawson and Swan; W. H. Preece (with enclosure); C. Martin; Dr. F. C. Calvert, F.R.S., F.E.S.J.; J. S. Parker; W. Hawkesworth; W. Sim (with enclosure); Smith and Son (with enclosure); Dr. E. Schunck, F.R.S.; Ritchie and Sons; Dr. S. Muspratt; C. Bailey; W. N. Hartley; G. G. Walmsley; J. Fordied; H. Mayne; G. Clarke; J. Winter Jones; S. E. Phillips (with enclosure); G. F. Rodwell; J. Wilkinson and Co.; L. F. Haseler, Queensland, Brisbane.

Books Received.—"Sound;" a course of Eight Lectures delivered at the Royal Institution of Great Britain, by John Tyndall, LL.D., F.R.S. Second edition. London: Longmans, Green, and Co. "What is Matter?" by An Inner Temular. London: Wyman and Sons. "The Retrospect of Medicine," edited by W. Braithwaite, M.D. Vol. lix. London: Simpkin, Marshall, and Co. "The Quarterly Journal of Science." "Popular Science Review."

AMERICAN SUPPLEMENT.

New York, September, 1869.

The Economical Purification of Zinc Containing Iron.

BY W. H. CHANDLER.

In the galvanizing of iron, the article to to be galvanized, after being thoroughly cleansed, is dipped into a kettle of molten zinc, which forms an alloy with the iron at the surface of contact, and by repeating the dipping the thickness of the superimposed zinc may be increased at pleasure. In the prosecution of this manufacture, the zinc is held in large iron troughs or kettles, which are rapidly corroded in those portions nearest the fire. An alloy of zinc and iron is formed, to which also the articles, being galvanized, in some degree contribute. This alloy being heavier than the purer zinc, sinks to the bottom and, from time to time, is removed by perforated ladles.

The composition of the alloy is of course somewhat variable, depending upon the temperature and fluidity of the zinc and the careful straining from the fluid metal. The two analyses here given were made by the writer a number of years since:

Zinc	94·27	94 15
Iron	5·46	5·
Lead	·27	·56
Tin	trace	·29
	100·00	100·00

These samples were taken from a remelting of a large quantity of the alloy, which is the only practicable method of obtaining a fair, average specimen.

The quantity of this dross or refuse is quite considerable, amounting probably, in the United States, to several hundred tons per annum. Formerly it was sold for use in coarse brass castings, and to some extent it was redistilled. At one establishment in Boston circular clay retorts, similar to those in use in the gas manufacture, were employed, the molten alloy being introduced through an inverted syphon in the iron mouthpiece and the condensing tube, connected with the reverse end of the retort, dipping in a pot of molten zinc; thus all access of air to the interior of the retort was prevented and little or no oxidation of the zinc occurred.

Several years since, a small lot of this refuse zinc was received at a metallurgical establishment in Massachusetts, in which the writer was employed as chemist, and in experimenting upon it, one of the foremen of establishment originated a method, by which the zinc could be obtained quite free from iron. Finally, after rebuilding his furnaces and in various ways altering and modifying his manipulations, the samples of purified zinc being analysed after each alteration of the process, a good commercial article was obtained containing only $\frac{1}{10}$ of one per cent of iron.

The process consists in melting the refuse in an iron kettle, raising the heat nearly to the point of volatilization of the zinc, and then by a proper regulation of the heat, cooling the mass slowly from the bottom, by means of a special arrangement of flues. An alloy of zinc and iron, containing a much larger percentage of iron than the original refuse, gradually forms, falls to the bottom of the kettle and is removed by a perforated ladle, while the fluid metal is much purer. The quantity of alloy to be ladled out depends upon the impurity of the original refuse. The purified zinc and the concentrated impurity are melted in separate kettles, and each treated as in the first operation.

One more fusion and refrigeration of the purified zinc and the still more impure zinc, render the former a good commercial spelter and the latter too impure for further economic treatment.

This process is the reverse in its reactions from Pattison's process for desilverizing silver-lead ores. In the latter case the purer lead crystallizes from the more fluid lead and silver, whereas in the former, the more impure alloy separates from the purified zinc.

The residue from this process, which is sold for distillation, consists of hexagonal prismatic crystals of a fixed alloy of iron and zinc, loosely agglomerated together so as to crumble in the hand.

When the operation of refining is badly conducted more or less zinc acts as a solder for the crystals. They are beautifully iridescent, exhibiting all the colors of the rainbow, owing to a surface oxidation. A number of specimens of various colors were selected for analysis and showed a composition of—

Zinc	90·50
Iron	9·50
	100·00

Upon fusing these crystals, which requires a high temperatures, and cooling as before, a small percentage of purified zinc is obtained, and an alloy containing as much as 12½ per cent of iron. This is compact, somewhat brittle and exhibits no evidences of crystallization.

This last mentioned fusion is not made in practice, as the great heat required for its accomplishment rapidly burns out the iron kettles.

By a similar process lead has been removed from zinc with great accuracy, the amount obtained closely approaching the quantity therein. From a lot of Silesian spelter was separated lead perfectly malleable, and containing scarcely a trace of zinc. The purification of the lead, obtained from the process of desilverization of silver-lead by means of zinc, could undoubtedly be accomplished by a modification of this process.

The Humboldt Centennial Celebration.

Upon the fourteenth of September next occurs the one-hundredth anniversary of the birth of this great savant.

In Berlin, the place of his birth and death, a national monument will be erected with appropriate ceremonies. In New York, a colossal bronze bust, representing him in the prime of life, will be unveiled with due solemnities. Professor Francis Lieber will deliver an address in German, and Professor John Draper in English. Numerous German singing societies will take part in the celebration. A banquet will also take place in Irving Hall. In Buffalo, ex-President Fillmore will deliver an address, to be followed by orations in German and English.

American Association for the Advancement of Science.

THE eighteenth meeting of the Association occurred at Salem, commencing Wednesday, August 18. The officers of the meeting were:

Col. J. W. Foster, of Chicago, President.

Prof. O. N. Rood, of New York, Vice-President.

Prof. Joseph Lovering, of Cambridge, Permanent Secretary.

Prof. O. C. Marsh, of New Haven, General Secretary.

Dr. A. L. Elwin, of Philadelphia, Treasurer.

Standing Committee.

Col. J. W. Foster.	Dr. B. A. Gould.
Prof. O. N. Rood.	Col. Charles Whittlesey.
Prof. Joseph Lovering.	Prof. A. P. Rockwell.
Prof. O. C. Marsh.	Dr. A. L. Elwyn.

The organization of the Sections was as follows:—

Section A.—Mathematics, Physics, and Chemistry.

Chairman, Prof Joseph Henry, of Washington, D. C.

Secretary, Prof. Henry Wurtz, of New York.

Section B.—Geology and Natural History.

Chairman, Prof. Louis Agassiz, of Cambridge.

Secretary, Prof. T. Sterry Hunt, of Montreal.

The following gentlemen were elected members of the Standing Committee:

Prof. J. S. Newberry and Prof. John Torry, of Columbia College; Prof. Agassiz and Prof. Benjamin Peirce, of Cambridge; Prof. Joseph Henry, of Washington, and Prof. T. Sterry Hunt, of Montreal.

New Mineral Springs.

We give below the analyses of the water of two new artesian wells at Ballston.

The Franklin Spring rises from a depth of 715 feet, the drill passing through the Hudson river shale, the Trenton limestone, the calciferous sand-rock and the Potsdam sandstone, the same strata as penetrated by the old "Ballston Artesian Spring."

The "Condedentonian" well is 600 feet deep, passing through the same strata as the "Franklin" except the Potsdam sandstone, which it does not reach. Both springs blow and spout every forty-eight hours.

	Franklin Spring.	Conde-Dento-nian Spring.	
Chloride of sodium	659·344	645·481	grains.
Chloride of potassium	33·930	9·232	"
Bromide of sodium	4·665	2·368	"
Iodide of sodium	0·235	0·225	"
Fluoride of calcium	trace	trace	"
Bicarbonate of Lithia	6·777	10·514	"
Bicarbonate of soda	94·604	34·400	"
Bicarbonate of magnesia	177·868	158·348	"
Bicarbonate of lime	202·332	178·484	"
Bicarbonate of strontia	0·002	0.189	"
Bicarbonate of baryta	1·231	4·739	"
Bicarbonate of iron	1.609	2·296	"
Sulphate of potassa	0·762	none	"
Phosphate of soda	0·011	0·003	"
Biborate of soda	trace	trace	"
Alumina	0·263	0.395	"
Silica	0·735	1·026	"
Organic matter	trace	trace	"
Total per gal. (231 cubic in.)	1184·368	1047·700	"
Carbonic acid gas	460·066	358·345	cub. in.
Density	1.0115	1·010	
Temperature	52°F.	49°F.	

The four analyses which follow are the results of examinations of the waters of Springs in Saratoga. The "Crystal" and "Hathorn's" Springs were recently discovered. The "United States" and "Pavilion" are the old Springs re-tubed. These six analyses were made in the editor's laboratory, the determination of the alkalies and alkaline earths being constantly checked by spectroscopic tests of the precipitates and filtrates.

	Pavilion Spring.	Hathorn's Spring.	
Chloride of sodium	459·903	509·968	grains.
Chloride of potassium	7·660	9·597	"
Bromide of sodium	0·987	1·534	"
Iodide of sodium	0·071	0·198	"
Fluoride of calcium	trace	trace	"
Bicarbonate of lithia	9·486	11·447	"
Bicarbonate of soda	3 764	4·288	"
Bicarbonate of magnesia	76·267	176·463	"
Bicarbonate of lime	120·169	170·646	"
Bicarbonate of strontia	trace	trace	"
Bicarbonate of baryta	0·875	1·737	"
Bicarbonate of iron	2·570	1·128	"
Sulphate of potassa	2·032	none	"
Phosphate of soda	0·007	0·006	"
Biborate of soda	trace	trace	"
Alumina	0·329	0·131	"
Silica	3·155	1·260	"
Organic matter	trace	trace	"
Total per gal. (231 cubic in.)	687·275	888·403	"
Carbonic acid gas	332·458	375·747	cub. in.
Density	1·0075	1,009	
Temperature.			

	Crystal Spring.	United States Spring.	
Chloride of sodium	328·468	141·872	grains
Chloride of potassium	8·327	8·624	"
Bromide of sodium	0·414	0·844	"
Iodide of sodium	0·066	0·047	"
Fluoride of calcium	trace	trace	"
Bicarbonate of lithia	4·326	4·847	"
Bicarbonate of soda	10·064	4·666	"
Bicarbonate of magnesia	75·161	72·883	"
Bicarbonate of lime	101·881	93·119	"
Bicarbonate of strontia	trace	0·018	"
Bicarbonate of baryta	0·726	0·909	"
Bicarbonate of iron	2·038	0·714	"
Sulphate of potassa	2·158	none	"
Phosphate of soda	0·009	0·016	"
Biborate of soda	trace	trace	"
Alumina	0·305	0·094	"
Silica	3·213	3·184	"
Organic matter	trace	trace	"
Total per gal. (231 cub. in.)	537·155	331·837	
Carbonic acid gas	317·452	245·734	cub. in.
Density	1·006	1·0035	
Temperature	50°		

Dangerous Kerosene and the So-called Safety Lamps.

July 22, Mrs. Curley, at No. 17 Hudson avenue, was fatally burned by kerosene; July 23, the building 23 Leonard street was fired; July 30, Carrie Autterfield, 264 West Houston street, died in great agony; August 4, Mrs. George T. Sammis, of Amityville, was, burned to a crisp; August 5, a fire occurred at 263 West Thirtieth street; a few days later Mrs. Caroline Hamblin 408 West Twenty-sixth street, was burned to death. The origin of all these accidents was "*kerosene oil*"—so-called.

The public is most wickedly misled by the venders

of lamps, "*patent safety lamps*," in which they are told they can burn any oil, even benzine, with safety. *Benzine cannot be made safe for use in dwellings, in the hands of women and children, no matter what lamp is employed.* One lamp may be a little safer than another when in perfect order; but lamps will break, oil will be accidentally spilled, the wick tube may be carelessly left unscrewed, in various ways the oil or the vapors may be brought in contact with flame, and, if it is not safe oil, an accident is sure to result. It would be far better for the public if there were no such thing as a "*safety lamp;*" in the full sense of the term there is not. Half the so-called "safety lamps" are no safer than the lamps, which make no claim to safety; while the other half are only safe as long as they are in perfect order and subject to no carelessness in filling or handling. *What is wanted is safe oil, then all lamps will be safe.*

Recent Chemical Patents.

Issued August 3, 1869.

93,157.—Electro-Deposition of Nickel. I. Adams Jr., Boston, Mass.

93,178.—Method of Producing Calcium Light. C. L. Coombe, Washington, D. C., and J. A. Bassett, Salem, Mass.

93,182.—Mode of Preserving Liquid and other Substances. R. D'Heureuse, New York.

93,183.—Preserving Meats, Poultry, Fish, &c. J. E. Dotch, Washington, D. C.

93,267.—Apparatus for Carburetting Air. J. F. Barker, Springfield, Mass., and C. N. Gilbert, New York.

93,270.—Receivers or Carboys for the Manufacture of Muriatic and other Acids. A. Baumgarten, New York.

93,286.—Apparatus for Purifying Whiskey and other Alcoholic Spirits. L. A. DeLime, St. Louis, Mo.

93,288.—Gas Caburetter. B. Dyer, New York.

93,339.—Filter. J. D. Parrot, Morristown, N. J.

93,342.—Electrical Railroad Signal. G. M. Phelps, Brooklyn, N. Y., and R. Stewart, Bordentown, N. J.

93,360.—Vapor-Burner. W. H. Smith, New York.

Issued August 10, 1869.

93,410.—Insulator for Lightning Rods. J. Burnham, Batavia, Ill.

93,411.—Compound Oil for Producing Gas. J. Butler, New York.

93,429.—Flask for Vulcanizing Rubber Plates for Setting Teeth. C. G. French, Springfield, Ill.

93,435.—Portable Gasometer. J. H. Hayward, New York.

93,452.—Apparatus for Utilizing Wells as Refrigerators. J. J. Kiser, Sulphur Springs, Ind.

93,477.—Process of Preparing Iceland and Irish Moss for use in Food. W. J. Rand, Brooklyn, N. Y.

93,478.—Manufacture from Iceland Moss and Carrageen. W. J. Rand, Brooklyn, N. Y.

93,498.—Tanning Composition. N. A. Thornton, Conikee, Ala.

93,523.—Distilling Alcoholic Spirits and Liquors. J. Dennis, Jr., Washington, D. C.

93,563.—Electrical Machine. H. J. Smith, Boston, Mass.

93,606.—Enamelling Wood and other Solid Materials with Hard Rubber. P. Finley, Memphis, Tenn.

93,607.—Deodorizing Compound. R. Fish, Washington D. C.

93,617.—Material for Lubricating Wool and other Animal Fibres. G. F. Henry, J. A. F. Bang, F. R. C. Monestier, and J. P. A. Figuier, Paris, France.

93,625.—Electro-Magnetic Machine. J. Kidder, New York.

93,640.—Modes of Desulphurizing Auriferous and other Sulphuret-Ores. J. H. Rae and T. T. Davis, Syracuse, N. Y.

93,643.—Kiln for Roasting Ores. J. M. Rohrer and J. H. Bassler, Pine Grove, Pa.

93,645.—Process and Apparatus for Extracting Oil from Vegetable and other Matters. T. Sim, Baltimore, Md.

Issued August 17th, 1869.

93,661.—Vapor Burner. J. E. Ambrose, Lombard, Ill.

93,674.—Vapor Burner. L. Chandler, St. Petersburg, Russia.

93,689.—Electro-Magnetic Engine. A. E. Dupas, New Orleans, La.

93,698.—Vapor Burner. T. S. Gates, and A. H. Fritchey, Columbus, O.

93,713.—Manufacture of Iron and Steel. J. Henderson, New York.

93,739.—Process for Purifying Paraffine. C. C. Parsons, New York.

93,752.—Explosive Compound for use in Fire-Arms, Blasting, &c. T. P. Shaffner, Louisville, Ky.

93,753.—Explosive Compound. T. P. Shaffner, Louisville, Ky.

93,754.—Explosive Compound. T. P. Shaffner, Louisville, Ky.

93,755.—Blasting Fuse. T. P. Shaffner, Louisville, Ky.

93,756.—Manufacture of Nitro-Glycerine. T. P. Shaffner, Louisville, Ky.

93,757.—Method of Blasting with Gunpowder, and other Explosive Substances. T. P. Shaffner, Louisville, Ky.

93,758.—Making Cast-Steel. C. W. Siemens, Westminster, England.

93,795.—Apparatus for Carburetting Air. J. F. Barker, Springfield, Mass., and C. N. Gilbert, New York.

93,817.—Manufacture of Sugar of Lead and Acetic Acid. L. D. Gale, Washington, D. C., and I. M. Gattman, New York.

93,840.—Cooling and Ventilating Apparatus. J. J. Schillinger, New York.

93,841.—Process of Preserving Vegetables. F. H. Smith, Baltimore, Md.

93,852.—Apparatus for Ærating and Cooling Distilled Water. G. W. Baird, U. S. N.

93,865.—Mode of Treating Bone-Black, for Filtering Sirups, &c. J. O. Donner, Jersey City, N. J.

93,895.—Single Microscope. J. H. Logan, Allegheny, Pa.

93,899.—Process of Treating Ores with Copper-Amalgam, by means of Electric Currents. A. L. Nolf, and F. L. A. Pioche, San Francisco, Cal.

93,900.—Material for Dyeing and Printing, obtained from Madder. A. Paraf, New York.

93,910.—Process of Treating Leather so as to render it Suitable for the Manufacture of Gloves, &c. N. C. Russell, Gloversville, N. Y.

93,923.—"Salt-Stone," for Salting Cattle and other Animals. V. A. Tugant, Mulbrouse, France, and P. Schüler, Bienne, Switzerland.

93,941.—Composition for Plastering Walls. D. Young, Kokomo, Ind.

Reissues.

38,003.—Reissue 3,594.—Mode of Purifying Cast-Iron. S. W. Kirk, Coatesville, Pa.

66,773, reissue 3,597.—Division A. Paint. D. R. Averill, New York.

66,773, reissue 3,598.—Division B. Paint. D. R. Averill, New York.

66,773, reissue 3,599.—Division C. Paint. D. R. Averill, New York.

66,773, reissue 3,600.—Division D. Paint. D. R. Averill, New York.

66,774, reissue 3,601.—Division E. Manufacture of Paints. D. R Averill, New York.

79,404, reissue 3,607.—Vapor Burner. J. D. Smith, Greig, N. Y.

85,115, reissue 3,612.—Tub for Distilling Essential Oils. B. P. Van Marter, Lyons, N. Y.

NEW PUBLICATIONS.

The First Annual Report of the Trustees of the Peabody Academy of Science. Salem, Mass.

This report comes to us in the form of a handsomely printed pamphlet of 108 pages. It contains a history of the institution, together with the official documents relating to its establishment, organization and plan of operations. It includes also the report of J. A. McNeil, on his expedition to Central America, and the reports of the curators of the various departments of the Museum. The Ethnological department is surpassed, in this country, only by that of the Smithsonian Institution.

On the Influence of Mental Activity on the Excretion of Phosphoric Acid by the Kidneys. By Luther Hodges Wood, Ph. B., M.D., Silliman Prize Thesis at the Medical Institution of Yale College. 1869. Pamphlet, 26 pp.

From a well-conducted series of experiments upon himself and a careful chemical examination of his urine, the author concludes that the variations, in the amount of phosphoric acid, are not sufficient to afford any indication of the previous mental condition.

He also favors the opinion that the nervous tissue does not disintegrate during healthy mental action, but that it grows, as has been proved true in regard to muscular tissue.

Traite des Matieres Colorantes, comprenant leurs Applications a la Teinture et a l'Impression, et des Notices sur les Fibres Textiles, les Epaississants, et les Mordants. Publié sous les auspices de la Société Industrielle de Mulhouse, et avec le concours de son comité de chimie, par M. P. Schützenberger. 2 vols. in-8 544, 647. Paris 1867.

In this work we have a compendious compilation of information from reliable sources, relating to the tinctorial art, which will supply a need long appreciated, of a manual of the art with its many recent improvements.

After a brief introduction, discussing a few fundamental chemical principles and the physical properties of colors, the author gives a succinct account of the origin of the various textile fibres, the history of their employment in the arts and their preparation for dyeing.

Then follow the general principles of the fixation of colors. The use of albumen is well and quite elaborately written, and the importance of this substance, to dyeing and calico-printing, fully impressed upon the reader.

The classification, of the coloring matters, adopted is as follows:

1. Mineral coloring matters.
2. Artificial organic coloring matters, including the derivatives of uric acid and aniline.
3. Artificial coloring matters, including the derivatives of phenic acid and naphthaline.
4. Vegetable and animal coloring matters.

The work is excellently illustrated by the insertion, under each coloring matter of specimens of cotton and silk fibrics, colored with the respective agents.

This is a most excellent feature of the work, greatly increasing its value.

The Journal of the Franklin Institute is ably edited by Prof. Henry Morton, Ph.D. Though principally devoted to civil and mechanical engineering, yet it always contains some matter interesting to chemists.

In the July and August numbers are articles upon spectrum analysis by the editor, and in the latter number some interesting spectroscopic notes by Prof. Young of Dartmouth College and an article upon the new chemical nomenclature by Dr. Adolph Ott, of New York.

The Journal is very handsomely printed and illustrated by numerous lithographs and wood-cuts.

BREVITIES.

Prof. John M. Ordway has been appointed Professor of Chemistry and Metallurgy in the Massachusetts Institute of Technology, the chair lately occupied by President Eliot of Harvard University. Prof. Ordway's ability as a chemist, and his great experience in technical chemistry, render this appointment especially fortunate.

Mr. B. M. Peirce has assumed the scientific editorship of *The Mining Journal* of Marquette, Michigan, in addition to his labors as Chemist of several iron mines. Mr. Peirce graduated at Harvard, and studied his profession at the School of Mines in Paris. He is a son of Prof. Pierce of Cambridge.

Prof. J. E. Sinclair, late of the Scientific Department of Dartmouth College, has been appointed to a Professorship in the Technical School at Worcester, Mass.

Prof. Chandler of the School of Mines, Columbia College, sailed for Europe, in the *City of Brooklyn*, for an absence of two months.

Prof. C. U. Shepard of Amherst has gone to Europe.

The seventeenth annual meeting of the Americal Pharmacentical Association will convene in Chicago, September 7th. The revision of the U. S. Pharmacopœia and the legal regulation of the practice of Pharmacy are prominent subjects for discussion.

Prof. Charles Avery, Professor of Natural Philosophy and Chemistry in Hamilton College, has resigned, and has been elected Emeritus Professor.

The Geological Cabinet of the late D. D. Owen has been bought by the Indiana State University.

The Republic of Uruguay has ordered the adoption of the Metrical system of weights and measures.

Nitro-Glycerine.—A bill has been introduced into the British Parliament, prohibiting the importation of this explosive, and rendering its manufacture and storage within the Kingdom subject to license regulations of the Home Secretary.

A Reminiscence of Barbarism.—The writing of physicians' prescriptions in Latin, and the numbering of the same, instead of a clear, plain statement of their composition and an intelligible label upon the package containing the medicine. In olden times, in the days of superstition and ignorance, the majority of the, so-called, physicians were sorcerers and charlatans, who supplemented their want of knowledge by mysterious signs and incantations; but in these days of enlightenment, when the true physician is a man of science, and his skill, not in reading Latin, but in the diagnosis and scientific treatment of disease, these ancient sophistries should be abandoned.

Guano.—The deposits of guano upon the Chincha Islands are nearly exhausted. The Peruvian Government, however, have commenced shipping from the Guanape Islands, where over one hundred vessels are reported waiting for cargoes. As to the value of the guano from these islands, and the extent of the deposits, there is no reliable information as yet. No analyses have yet been published, and the depth of guano is variously stated from twenty to sixty feet. Should this supply prove temporary, the prospects of the West Indian and North American phosphate deposits will be greatly improved. Guano was first imported into England from Peru, in 1826, the business increasing very rapidly. In 1852, 300,000 tons were sold in the United States and Great Britain. In 1854, the quantity remaining upon the Chinchas was estimated at 8,000,000 tons. This estimate was thought to be much below the actual quantity. It has proved, however, to be not far from the truth.

Important Spectroscopic Observations.—During the eclipse of the sun upon August 7th, Prof. Harkness, at Des Moines, Iowa, and Prof. Winlock, at Shelbyville, Kentucky, observed a number of new lines in the rose-colored protuberances of the sun. The latter observer notes eleven lines in place of five heretofore mentioned. Different spectra were obtained from different protuberances, indicating a variety in composition. These protuberances have been heretofore pronounced, by European astronomers, to be mainly composed of incandescent hydrogen.

A New Polytechnic School.—A party of gentlemen from Louisville, Kentucky, recently made a tour of inspection among the Eastern Colleges, collecting information preliminary to the establishment of a polytechnic department of the Louisville High School. As an educational institution, this school already maintains a higher position than many of the so-called universities and colleges in the United States, and we are glad to chronicle this new movement.

The Trustees of Dartmouth College have voted $25,000 in aid of the building for the Agricultural College.

Mr. George Peabody has given $140,000 for the promotion of science and useful knowledge in the county of Essex, Mass. The gift is placed in the care of trustees named by Mr. Peabody.

The Kent Scientific Institute, of Grand Rapids, Mich., propose to execute a geological survey of Kent and the adjoining counties during the next two years.

THE CHEMICAL NEWS.
Vol. V. No. 4. American Reprint.

THE SPECIFIC GRAVITIES OF LIQUIDS AND SOLIDS THEORETICALLY CONSIDERED.

BY DR. J. G. MACVICAR,

MOFFAT, N. B.

It is generally understood that Euclid shaped his Elements expressly to the end that ultimately he might be able to demonstrate the properties of the regular polyhedra, whose importance in every system of morphology he saw clearly; while Plato flew at them directly as the very forms of the elements of Nature. There is, therefore, nothing contrary to the traditions of philosophy in its highest walks in the supposition that the forms of the molecules of bodies, when they have been so far perfected as to have become individualised, possess the forms of the regular polyhedra. Now, if we suppose that the ultimate material element or unit of atomic weight or force is the same in all substances whatever—a supposition which has, also, the highest sanctions of philosophy in its favour, and which, though set aside for a time, begins again to be more and more favourably considered every day—and adopt the law of symmetry as the law by which these units of weight shall aggregate into groups or molecules which shall be more or less stable, we shall be conducted, by the progress of the synthesis, whether we will or no, to these regular polyhedra as the forms and structures in which that synthesis culminates, and especially to the *tetrahedron*, the *icosahedron*, and the *dodecahedron*, which are intimately related to each other.

Nor is there anything to be regretted in this conclusion; on the contrary, it is impossible for any one who has mastered the details of chemistry considered as a science of phenomena, and not of hypothesis, not to perceive—if he will but consent to look at tha twhich implies a great revolution in this science—that this doctrine of polyhedral molecules explains a multitude of facts and phenomena, which, in all the lights the hitherto amorphous chemistry can bring to bear upon them, are utterly dark, and merely matters of wonder.

But, instead of indulging in general statements, let us prove the statement in reference to the weights of bodies, one of their most important physical properties. It will be admitted that the popular chemistry can tell whether a liquid or solid is light or heavy only after having weighed it, either by the hand or the balance. Why a piece of sulphur should weigh less than twice as much as an equal volume of water, while a piece of zinc, whose atomic weight is about the same as that of sulphur, should weigh more than seven times as much, and, indeed, generally, why the weight of any body should be what it is, and not otherwise, chemistry can assign no reason. It has, indeed, a hypothesis of atomic volume by which (though not without continual embarrassments) specific gravities may be calculated; but that atomic volume is itself a function of the specific gravity as ascertained by weighing the substance; it is, therefore, merely a complication, not an explaination.

Now, the molecular philosophy which is here advocated solves the problem of specific gravities in the most satisfactory manner; for it does so not by introducing any new formula on this subject into science, but solely by the extension to liquids and solids of the law by which the specific gravities of aëriforms have been calculated ever since the days of Gay Lussac. Having found the right molecules which constitute liquids and crystals (the regular polyhedra, namely), it shows that their volumes tend to be equal, and either actually are equal or in a simple ratio to each other, just as has been long ago found in the case of aëriforms.

I have had occasion already to name sulphur: I will show the truth of what I have now affirmed in reference to sulphur and its companion oxygen, two elements which, after hydrogen itself, are the first to show themselves in our synthesis of the elements.

In the nascent state, they are so related morphologically that they may be viewed as the complements of each other, and the reciprocal forms of the same materials. They have accordingly in this their primal state the same atomic weight, and that is 8 when hydrogen is taken as unity. But so defective is the single atom of oxygen in a proper length of axis that, as often as two meet in the same neighbourhood, they must, under the law of symmetry, couple on the same axis; and thus the unit volume of oxygen gas will weigh $2 \times 8 = 16$ when $H = 1$. Similarly so defective is the single atom of sulphur (which, to prevent confusion, we may call sulph) in its equatorial region that each atom must tend to fix three others into this region; so that sulph is to be expected in nature usually in tetratoms, the atomic weight of the tetratom being 4×8 32, which is an atom of sulphur, a state of things which it will be desirable to indicate in symbols, thus—

The tetratom of sulph, $S_4 = \mathbb{S}$, one atom of sulphur.

And here I may remark that, in constituting the tetratom, the atom of sulph has come to constitute a form which is more highly oblate or negative than the single atom was prolate or positive; so that in order to lengthen the axis, tetratoms, when rising into the aëriform state, tend to form unit volumes, not consisting of two atoms merely, as in the case of normal oxygen gas, but three, as in the case of that ozone which weighs $1\frac{1}{2}$ times as much as oxygen gas; a mode of association being normal in the case of suphur (except at a high temperature, which is exceptional in the case of oxygen.

If it be asked how do I come to know, or, at least, to believe, all that, the answer is that I have done so by thinking upon the subject during the leisure of a lifetime, keeping thought all the time abreast of the phenomena of nature and the laboratory. You say it is all a mere imagination, not entitled to the regard of men of science. Well, if you say so after having given this communication a fair reading to its close, I shall leave you, without further molestation, to the free enjoyment of your opinion.

I am now to deduce *à priori* the specific gravity of sulphur and its well-known combinations with hydrogen and oxygen. It is necessary only to premise further that of the two orders of forms—the trigonal and the pentagonal—under one or other of which all terrestrial elements are included, sulphur and hydrogen belong to the trigonal, oxygen and most other elements to the pentagonal. Hence, sulphic and sulphuric molecules and those in which atoms of hydrogen are centrad, must be icosahedral or tetrahedral, for, in these polyhedra, the facets are triangles, while oxygen and most other elements tend to form dodecahedral molecules, for in these the facets are pentagonal. With regard to water, whose molecule gives the unit volume for specific gravities, it is doubly trigonal (hexagonal), whence

[English Edition, Vol. XX., No. 506, page 61.]

it tends to stretch out into laminæ rather than to turn round into molecules; and to constitute one particle of water no fewer than 36 atoms of vapour are required, the atomic weight of the aqueous unit consequently being $36 \times 9 = 324$, when H=1. No doubt without such evidence as I cannot here reproduce, you will refuse to believe all this. But you will perceive that this reference to the weight of the unit volume of the aqueous element is not necessary to substantiate the fact of my being able to deduce the relative weights of liquids and solids. It is only necessary to enable me to present specific gravities in the usual form, that is, in relation to water as unity. And here I may mention that in giving specific gravities it is usually unnecessary to go beyond the second decimal place, because even it depends on the temperature of the experimental determination as also on peculiarities of internal molecular structure and action which we cannot enter into.

Sulphur.—Its atomic weight is 32; its form is of the trigonal order. Its molecule of culmination is therefore icosahedral, and its volume may be inferred to be normal, that is, equal to the unit volume of water, which is the great assimilative agent on the terraqueous globe. This gives—

$$\text{Sulphur } G = \frac{S_{20}}{AQ} = \frac{20 \times 32}{324} = 1{\cdot}96. \quad \text{Exp. } 1{\cdot}96. \ 2{\cdot}0$$

Here, then, we deduce the specific gravity of sulphur, as found by the balance. I have shown also that the dimorphism of the crystals of sulphur and its plasticity, when fixed by sudden cooling under molecular change at a certain temperature, are involved in the form of this element.

Hodrosulphuric Acid.—The form of the atom of sulphur being oblate or negative, it comes to pass that, in order to lengthen its axis, it must tend to fix an atom of hydrogen on each pole, giving $HSH = H_2S$, which is the well-known formula of sulphuretted hydrogen. Now, of this combination, as of sulphur itself, the molecule must be icosahedral, for an atom of H must be centrad, and H is trigonal as well as S. But the molecule, consisting as it does of 20 parts, and with three elements stuck into the axis of each, must be much larger than merely the icosatom of sulphur. Allowing, then, to this molecule that which after one in simplicity of ratio comes next to one, viz., two normal or aqueous volumes, we obtain for—

$$\text{Hydrosulphuric solid } G = \frac{(HSH)_{20}}{2AQ} = \frac{20(1+32+1)}{2 \times 324} = 1{\cdot}05$$

Now this fœtid gas when forced down into a liquid has been estimated at 0·9, and the solid has been found to sink in the liquid. Our theoretical specific gravity may therefore be regarded as accurate. But in these forced liquids and solids it is impossible to know how much aëriform matter may be included in them, increasing their bulk without a proportional increase of weight. For this reason I shall pass lightly over sulphurous acid also. Our theory gives 1·58 as its specific gravity. The liquid has been estimated at 1·45, and the solid was seen to be heavier. The theoretical number may therefore be accepted.

Sulphuric Acid, or Anhydride.—The combination SO_3 of the most modern notation is $S_4O_6 = SO_6$ of ours. Its form is so oblate that if two come into the same neighbourhood they must couple, giving $SO_{12}S = 2SO_3$ Auct. And here we obviously have the proper molecule of oxygen, namely, the dodecatom as *the* body of the combination, carrying a tetratom of sulph or an atom of sulphur on each pole differentiating that dodecatom. Now, these molecules are so large that if they were to form into icosatoms, as their trigonal poles would oblige them to do, they would be out of all keeping with the unit volume of water. Rather than the last of the trigonal series of polyhedrons, then the icosahedral, let us expect the first, viz., the tetrahedral molecule; we thus obtain—

$$\text{Sulphuric acid } \frac{(SO_{12}S)_4}{AQ} = \frac{4(32+96\times32)}{324} = 1{\cdot}97. \quad \text{Exp. } 1{\cdot}97.$$

The tetrahedral molecule presents itself in the case of other analogous substances, that is, differentiated dodecatoms composed in great measure of elements tending to the free or aëriform state. Thus the strongest (monohydrated) nitric acid by doubling the chemical formula, as usual, gives $N_2O_{10},2HO$, which, when written symmetrically, gives—

$$\text{Nitric acid } G = \frac{(HONO_{10}NOH)_4}{AQ} = 1{\cdot}55. \quad \text{Exp. } 1{\cdot}55. \ 1{\cdot}52.$$

But to return to sulphuric anhydride—

Such a structure in the terraqueous globe must necessarily be very restless, and though it is found in nature (taurocholic acid, &c.) as well as has been constructed in the laboratory, the combination of sulphur and oxygen usually stops in the production of sulphates, or, as I should say, sulphurates, which are very finely differentiated, and, therefore, very stable combinations, secure from the further attacks of oxygen by being already covered on the poles by the oxygen of the metallic oxide which enters into their composition. Following the mineralogists in using a dot for an atom of oxygen, some idea of the structure of an element of a sulphurate may be given thus—

$$\text{A sulphurate .. .. } OM\overset{\cdot\cdot}{\underset{\cdot\cdot}{S}}MO = M_2SO_4 \text{ Auct.}$$

Their poles being oxygens their molecules must be dodecatoms. And as they have all undergone a severe ordeal these dodecatoms may be expected to be differentiated by the fixing of a single element of the sulphurate on each pole. Taking three of the most familiar sulphates of nature, if you make the calculation you will obtain the following results—

$$\text{Anhydrite .. } G = \frac{(Ca_2SO_4)1+12+1}{AQ} = 2{\cdot}95. \quad \text{Exp. } 2{\cdot}90.$$

$$\text{Celestine .. } G = \frac{(Sr_2SO_4)1+12+1}{AQ} = 3{\cdot}97. \quad \text{“ } 3{\cdot}95.$$

$$\text{Barytes .. } G = \frac{(Ba_2SO_4)1+12+1}{AQ} = 4{\cdot}64. \quad \text{“ } 4{\cdot}70.$$

It is time to remark, however, that both in nature and the laboratory the atom of sulphur often resolves itself into the four atoms of sulph of which it consists, and thus we have sulphous and sulphic acids as well as sulphurous and sulphuric. The presence of moisture especially assists in this partitionment. Taking sulphuric anhydride as the type in the absence of moisture, then, on the access of moisture to it, an atom of aq may be expected to attack and to fix itself on each of the four summits of the four atoms of sulph which constitute the poles. And after this it is only to be expected that the differentiated dodecatom, now rendered too diffuse, shall break up into four atoms of dihydrated sulphic acid or glacial oil of vitriol, which, therefore, we must regard as the normal or most natural hydrate.

Glacial Oil of Vitriol.—It may be shown that one of its poles is sulphic and the other aqueous. Its

molecule may therefore possibly be either the icosatom, consisting of 20, or the aqueous, consisting of 36 elements. But of these the latter plainly could not endure the high temperature of boiling oil of vitriol. Its molecule therefore must be icosahedral. Now

Glacial Oil of Vitriol $G = \frac{(SO_{32}HO)_{20}}{2A2} = 1{\cdot}79$. Exp. 1·75.

When, however, this acid is produced in the cool of nature, and its stability increased by the incrustation of the molecule by lime, we obtain evidence that the acquaform molecule has been constructed, the sulphocalcic molecule being so large as to occupy four aqueous volumes. Thus—

Gypsum $G = \frac{(CaOSO_3.2HO)_{36}}{4AQ} = 2{\cdot}39$. Exp. 2·3. 2·4.

As to the strongest oil of vitriol which can be obtained by boiling, it has been observed by the best chemists that they cannot drive off the whole of the second atom of the water which is in the glacial acid. It has been observed that, strange to say, just 1-12th of an atom of water remains for every atom of monohydrate obtained. Now, here, when viewed in the light of our molecular morphology there is nothing strange. An atom of moisture has just twelve points or summits to which such bodies as atoms of oil of vitriol could attach themselves. And what has happened under the heat and violence of the long-continued boiling is obviously this, that the icosatoms of the glacial acid have been broken up, and the single elements of oil of vitriol, thus set free, have gathered round particles of moisture as nuclei, each atom of Aq being competent to accommodate 12 atoms of oil of vitriol around it.

That this is the true interpretation of the phenomenon is proved by the specific gravity. Thus—

Strongest oil of vitriol $G = \frac{(SO_3.HO)_{12} + Aq.}{AQ} = 1{\cdot}843$. Exp. 1·843.

That there are sulphurides and sulphides also, as well as sulphurates and sulphates, is shown by the same test.

Sulphuride of zinc $\frac{(Zn\overline{S}Zn)1+12+1}{AQ} = 4{\cdot}15$. Exp. 4·16.

But the same formula applied to Galena gives G= 10·34, or, possibly, 5·17 if occupying two normal volumes, while the balance gives G=7·4. Now, placing the metal as the body of the molecule and an atom of sulph in each pole (which must give the same percentages on analysis), we obtain—

Sulphide of lead $\frac{(SPbS)_{20}}{AQ} = 7{\cdot}4$. Exp. 7·4.

I only add that selenium comes out as baric, and tellurium as barytic sulphur, and that thallium comes out as one of a series of five metals, of which lead, gold, cadmium, indium, are other members, the body of the atom of thallium being an icosatom of sulph, and the poles atoms of sodium welded on that body.

ON

HEAT TREATED AS A SCIENCE OF KINETICS.*

BY G. F. RODWELL, F.C.S.

(Concluded from Am. Rep., Sept., '69 page 136.)

IV. (Abstract).

This lecture was entirely devoted to radiant heat: the principal definitions are given below.

If a mass of matter possessing a greater amount of molecular motion than the matter around it (a heated ball of metal, for example) be placed in a space devoid of all directly recognisable matter (a vacuum), it is found that it rapidly loses its motion until it assumes the temperature of proximate surrounding bodies; and, inasmuch as that motion proceeds in straight lines in every direction, like the radii of a circle, the action is known as *radiation*, and the motion thus transmitted as *radiant heat*. (*Radius*, a rod, the spoke of a wheel, related to ραβδος. *Radio*, to emit beams, to shine, is not unfrequently used by the Ancients; thus Lucretius "*rubent radiati lumina solis.*").

It is impossible, *à priori*, that in this case there can be direct transmission of heat by conduction (Lecture III.) or by convection (Lecture III.). The motion is not communicated to visible and readily-recognisable matter, but to that infinitely subtle matter called the *ether* or *interstellar* medium (Αιθηρ of the Ancients—Lecture I.); and it is believed to travel in progressive waves, that is, such waves as are produced when a long cord fixed at one end is rapidly jerked up and down. There is no transference of matter, only of motion; and each particle of the ether actuated by the motion moves at right angles to the direction of transmission. (The belief in the existence of a matter infinitely more subtle than air has pervaded philosophy from the very earliest times; it is distinctly enunciated in several of the oldest systems of Hindoo philosophy, at least 900 years B.C. It appears in Greek philosophy—most notably in that of Aristotle; and many of the Middle Age systems are founded upon this assumption. In the "Materia Cœlestis" of Descartes, we have the ether endued with various properties, inducing conditions of physical change; among others, he has assigned to it the production of all motion, an idea which accords well with Aristotle's derivation of Αιθηρ from αει and θεω. In the "Phlogiston" of Stahl, we have the ether endued with various properties, inducing conditions of chemical change, the chemical phase of the "Materia Cœlestis." In some form or other, the assumption is essential to physical philosophy; for without it all radiant actions would be quite inexplicable. In support of the existence of the ether, we have—(α) Various phenomena connected with light, as has been shown by Euler, Huyghens, Young, and others; (β) the shortening of the path of Encke's comet, the period of revolution of which is 3¼ years, which is diminished by about 0·11 of a day at each revolution; and it is probable that all the visible motions of the universe are likewise becoming lessened by the same resistance; (γ) the experiment of Foucault on the production of heat by the rotation of a copper disc between the poles of a magnet.*)

Radiant heat is closely related to light; indeed, we have every reason for believing that the motion which constitutes heat is only a slower form of the motion which constitutes light; in a word, that the difference is one of degree rather than of form. Thus, if we heat a mass of metal, it gradually assimulates molecular motion until, at a certain point (*red heat*), it emits light, and the more motion it receives, the more intense does the light become, until at length it emits white light (*white*

* A course of four lectures delivered at the London Institution.

* The experiments of Balfour Stewart and Tait on the production of heat by the rapid revolution of a disc *in vacuo* appeared to support the hypothesis of an ether; but a paper in the *Philosophical Magazine*, for this month (January, 1869) traces the production of heat to other causes than ethereal friction. The velocity of an ether particle must be inconceivably great, since it has been calculated by Clausius that the velocity of a particle of hydrogen at the freezing temperature is 6050 feet per second; and the ether must be conceived to be infinitely less dense than hydrogen.

heat). Again, when light is decomposed by a prism, that is, when the various ether waves which, in virtue of difference of oscillation, constitute differently coloured lights, are separated, so that waves of one definite velocity appear in one definite place, it is found that, beyond the slowest waves of light, there are waves of radiant heat of extreme power.

Radiant heat is capable of *reflection* (*reflecto* to turn back); and it obeys the same laws as light. Reflection may be defined as the turning back of the ether waves by molecules which cannot assimulate the motion thus conveyed; as when a cord is fixed to a rigid body, and caused to undulate, the wave which travels along it stops when it reaches the fixed end, and then returns, because the rigid body is incompetent to assimilate the motion which the molecules of the cord convey. [This is well illustrated by causing waves to propagate themselves by rapidly jerking a cord of hemp or india-rubber fixed at one end; the cord may be from 4 to 6 millimetres in diameter; or a small brass chain from 5 to 10 metres in length, may be advantageously employed. It should be fixed horizontally, the room darkened, and a beam of light from the electric or oxyhydrogen lamp should be caused to illumine the path of the chain. Communicated undulations are now seen with great clearness to travel to the fixed end of the chain, and, finding there nothing which can assimilate the motion, to return as a reflected wave. The undulations of a row of particles can be shown by fixing at one end a broad and lengthy band of paper, and communicating undulatory motion, as in the case of the cord. The paper best adapted for this purpose is a kind of thin drawing paper, sold in lengths of 36 feet, and 3½ feet broad. In regard to the mirrors to be used for showing the reflection of heat, it is quite essential to success that their axes should coincide *perfectly* (in the experiment, for example, in which a hot ball of metal is placed in the focus of one mirror, and the bulb of a differential air thermometer or a thermo-pile in the focus of another and distant mirror): this can only be the case when the curves are similar, when their centres are in the same horizontal plane, and when the lines joining the opposite extremities of each curve are parallel. The focus may be indicated to the audience by allowing a cylinder of rays of light, of the same diameter as the mirror, to fall upon it, while some fine dust, such as lycopodium or a little volatilised chloride of ammonium, is diffused in the air in front of the mirror; the precise position for the thermometer in the succeeding experiment of reflected heat is thus indicated. The mirrors should be parabolic, not spherical; that is to say, their surface should be generated by the revolution of an arc of a parabola about its axis, not by the revolution of an arc of a circle about the radius which unites the middle of it to the centre of the circle to which it belongs. The smaller mirrors which are sold in this country for experiments on radiant heat are, for the most part, spherical; but very good parabolic mirrors can be obtained in Paris]

Radiant heat is capable of being *refracted* (*frango*, to break up; akin to ραγνυω); that is, the motion of the ether waves may be turned, by their passage through certain media, so as to proceed in a different direction, and in an extended form.

The *absorption* (*absorbeo*, to swallow up, or devour) of heat is the reception of the motion from the ether by molecules of matter. It is thus a reverse action to reflection; for absorption pre-supposes that the molecules of the absorbing body readily assimilate the motion. *Such molecules* may be represented by small wooden balls suspended in the path of a cord, which latter, when caused to undulate, communicates its motion to the balls. (This action may well be shown by fixing a tense india-rubber cord in such a way that its ends may be free; this can be done by connecting it with four rigid supports by thick strings, which is fastened near each extremity, and passes away to the supports, making an angle of about 60° with the cord. This tense cord represents a row of particles of ether. A leaden ball, about 3 centimetres diameter, is suspended by two strings, so as to cause it to oscillate in one plane, the end of the india-rubber cord being the limit of vibration in one direction—that is, the oscillating ball can be caused to impinge upon one end of the tense cord. At the other end of the cord, and in various positions along its path, small wooden balls, about 3 centimetres diameter, are suspended. When the oscillating leaden ball strikes the tense cord, the latter is thrown into vibration, and communicates motion to the small balls in contact with it, thus illustrating both radiation and absorption; for the lead ball represents a molecule radiating heat (viz., communicating its motion to the ether), while the wooden balls represent molecules absorbing heat (viz., receiving motion from the ether.) These illustrations may appear crude, but they at least assist an audience to realize some more or less obscure molecular actions, and a mere statement of them is scarcely sufficient.)

Of the total radiation of the sun, only $\frac{1}{2,300,000,000}$ths is received by the earth. In one year the amount of heat thus received would liquefy a layer of ice 100 feet thick, covering the entire surface of the earth. With the exception of the energy of tides (that is, the energy derived from the ebb and flow of the tides, which results from the attraction of the moon, and tends to diminish the energy of the earth's revolution), the sun is the source of all our available energy—the energy of food and fuel, of water and air in motion. The most dominant attractive forces against which this energy is exerted are—(α.) *Gravity*, the attraction existing between the masses of matter (Lecture I.); (β) *Chemical affinity*, the attraction existing between dissimilar molecules of matter (Lecture I.); and (γ) *Cohesion*, the attraction existing between similar molecules of matter (Lecture II. and III.) This last,—that is, the energy expended in the internal work of a mass of matter (Lecture III.),—enormous as it is, is obviously unavailable to mankind.

The concluding remarks are given below *in extenso*.

The phenomena of the universe, infinite as they are in variety, in form, in magnitude, and in effect, appear to be almost all produced by the interaction of attractive forces with forces of motion, the former tending to produce conditions of stability, the latter conditions of instability. These forces undergo a ceaseless round of change, in which their form alone is altered, while their actual energy, whether it be kinetic or potential, remains the same; for the sum of the energy of the universe is a constant quantity. Circular motion may become elliptic; elliptic motion may become rectilinear; molecules may possess individual motion, or they may move in groups, or they may be actuated by both motions simultaneously; or, again, they may be influenced in innumerable ways by contiguous molecules, which may lessen their motion in one direction and augment it in another, and may change its form, intensity, character, or duration; but, throughout all

these changes, the actual initial amount of energy is present in some form or other. The changes are precise and definite, and they follow unvarying and immutable laws; does it not, therefore, appear reasonable that the Pythagoreans made the most prominent feature of their philosophy the belief that unity and law and an eternal harmony prevail in the affairs of nature?

In the foregoing lectures we have briefly considered one of the dominant motions of the Universe; and we have seen how it is generated, how it influences matter, and how it passes into other forms. From first to last, we cannot fail to have noticed that it is most inimical to rest; that it ever tends to convert a condition of rest into a condition of, at least, temporary unrest. Indeed, we are almost disposed to regard *it*—a motion of molecules—as a condensed form of the motion of masses, since we have learnt that an increase of warmth in a mass of matter too slight to be felt, truly represents a force competent to lift that same mass to a height of many hundred feet; and the old Parmenidean dogma that heat is the cause of all the motion in the Universe * appears more reasonable than ever before. Not only has heat become a science of kinetics, but physical science itself is daily becoming more kinetic in its character, and there can be no doubt that other of the so-called physical forces besides light and heat will, sooner or later, be resolved into forms of motion. I have before spoken of the physical philosophy of Descartes as, perhaps, the most comprehensive kinetic system which has appeared in the whole history of science; and I am often reminded that, in our treatment of certain branches of science (specially in that of heat), we follow closely in his footsteps; in fact, our modern physical philosophy may almost be called *Neo-Cartesianism*. It is much to be wished that we adopted the Cartesian metaphysics to the same extent, in place of the pernicious Positivism † which now prevails. The philosophic spirit of the age tends towards the establishment of a syncretism between the philosophy of matter and the philosophy of mind; and, while the former has scarcely been elevated by the means, the latter has undeniably been degraded and materialized. A moment's comparison with the Platonic philosophy will convince us of this. The Positivists would have us apply to both mental and physical philosophy the same laws and the same modes of treatment; they would have us believe that only which is capable of direct demonstration; they would make the intellect infallible, and the senses all but infallible, forgetting how utterly relative is all our knowledge, and how we necessarily judge of things more in relation to ourselves than in relation to the great Universe around us.‡ It is a hard, unyielding philosophy, which weakens some of the finer attributes of our nature, and destroys faith; it is a philosophy which engenders intense intellectual pride, for it induces our finite intellect to place itself on a level with Infinite Intellect. Rather than this, I say, let us adopt the Cartesian philosophy, and take, as our first principle of certainty, *Cogito ergo sum*.* "To think," says a learned divine of our day, "is to see the chain of facts in creation, and, passing along its golden links, to find the hand of God at the beginning, as we saw his handiwork in its course."† In this spirit did Descartes think; in this spirit did he propound the first proposition of his system—"Cogito ergo sum."

The path of pure and divine philosophy is rugged with mounds which men have raised from time to time in the hope of seeing further than their fellows—back into the past, forward into the future; and many of these contain within them the festering remains of dead philosophies, which the world has buried out of her sight for their very loathsomeness. Albeit travellers often ascend these lofty tombs, allured by the hope of getting a clearer view of the distant land they seek; and, when they reach the summit, they are wearied, the time is far spent, and, as the light of day fades from their eyes, and darkness obscures the road, they lie them down, and rest side by side with the corpse of the philosophy which has seduced them. Almost at the outset of our journey, we pass a neglected mound, upon which the traveller has long ceased to rest; and it bears, in nearly defaced characters, the names of Gorgias and Protagoras. Near it, we see a greater eminence, raised by Socrates, and augmented by Cynics, and Megarics, and Cyrenaics. A very mountain bears the name of Aristotle. Many such mounds we pass; some overgrown with underwood, from which peep the ruins of forgotten shrines; some covered with asphodels and cypresses, some with myrtles and with bays, while others, again, are mere morasses, dangerous to tread upon, and rife with disease. Such an one is seen in a misshapen mound, reeking with decay, and too loathsome to approach; the home of vultures, and of ghouls, and of unclean beasts; and it bears the names of Diderot, La Mettrie.‡ Somewhat near to this, we see an eminence which, although new, is gigantic in its propor-

* Parmenides, of Elea, according to Aristotle, Diogenes Laertius, and others, propounded this idea. It was afterwards adopted by Telesius of Cosenza, and other Middle Age philosophers, and in a modified form by Descartes.

† A good account of the most modern phases of Positivism is given by Ravaisson in his "Philosophie en France au XIXieme. Siécle."

‡ The following extract from the treatise "De Sapientia Veterum" of Francis Bacon would appear to be peculiarly applicable to a certain sect of philosophers of our day. At the same time, we do not wish to give to the word φιλόσοφος the same significance as did some of the Greek Fathers—S. Chrysostom, for example, in his charmingly eloquent Ὁμιλια εις Ευτροπιον. Pentheus, it will be remembered, hid him elf in a wood, in order to be a spectator of the hidden mysteries of a Bacchanalian revel, but, being perceived, he was smitten with a kind of frenzy, one result of which was that he saw everything double, and thus vacillated between the unreal and the real. A detail account of his doings is given both by Euripides and by Ovid, and the force of the following passage will be scarcely realized unless the reader be familiar with one or other of these accounts. "Alia est Penthei calamitas. Qui enim ausu temerario, mortalitatis parum memores per excelsa Naturæ et Philosophiæ fastigia (tanquam arbore conscensa) ad mysteria divina adspirant, ils pœna proposita est, perpetuæ inconstantiæ, et judicii vacillantis, et perplexi. Cum enim aliud sit lumen Naturæ, aliud Divinum; ita cum illis sic, ac si duos Soles viderent. Cumque actiones vitæ et decreta voluntatis ab intellectu pendeant: sequitur etiam ut non minus voluntate, quam opinione hæsitent nec sibi omnino constent: Itaque et duas Thebas similiter vident. Per Thebas enim actionum fines describuntur (cum Thebis Pentheo esset domus et perfugium). Hinc fit, ut nesciant, quo se vertant, sed de summa rerum inc erti et fluctuantes, tantum subitis mentis impulsibus in singulis circumagantur."

* "Sic autem regicientes illa omnia, de quibus aliquo modo possumus dubitare, ac etiam falsa esse fingentes; facilè quidem supponimus nullum esse Deum, nullum cœlum, nulla corpora; nosque etiam ipsos non habere manus, nec pedes, nec denique ullum corpus; non autem ideo nos qui talia cogitamus nihil esse: repugnat enim, ut putemus id quod cogitat, eo ipso tempore quo cogitat, non existere. Ac projinide hæc cognitio, *Ego cogito, ergo sum*, est omnium prima et certissima, quæ cuilibet ordine philosophanti occurrat."—*Principia Philosophiæ*, lib. i., p. 7.

† "The Limits of Philosophical Inquiry," an address delivered to the Members of the Edinburgh Philosophical Institution, on November 6th, 1868, by William, Lord Archbishop of York.

‡ The "Système de la Nature" of La Mettrie is one of the most vilely assumptive and irrational works which has appeared in the whole history of thought. Published during the most gross and rampant period of French materialism, it aimed at the destruction of ideas spiritual, ethical, and philosophical, which have ever been inseparable from the human mind; which have been cherished by races the most diverse in every age and every civilized country. Ideas which belong as much to Koung-fou-tzeu, to Zoroaster, and to the Vedic Brahmans as to Plato, Socrates, and Seneca, or to the thinkers of our day.

tions; it is the resort of innumerable travellers of every race and of every creed, and they help to raise it higher, for they would fain climb to heaven by its means; and upon it we read the name of Auguste Comte. But what graceful peak rears its head sublime above the plain? it pierces the very clouds; it is clothed with amaranths, and it bears upon its summit a fane dedicated to Immortality. Lo! the calm, the sovereign, the ineffable spirit of Plato dwells therein. Here, as *we* travel along the path of philosophy, let us rest; here let us throw down our burden of modern Positivism, and then start afresh, Platonised in spirit and in thought.

PROCESS FOR DETERMINING THE CARBON CHEMICALLY COMBINED WITH IRON.*

BY PROFESSOR EGGERTZ,

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When steel or pig-iron containing carbon in chemical combination is dissolved in nitric acid, a soluble brown colouring matter is formed whose colouring power is quite intense, and the solution assumes a tint which is dark in proportion to the quantity of the chemically-combined carbon.

Iron and graphite (or free carbon) do not influence this colouring; for the solution of nitrate of iron is colourless, or, at most, slightly greenish, unless extremely concentrated, and graphite is insoluble in nitric acid.

Thus, in dissolving two pieces of different steels of the same weight in nitric acid, taking care to dilute the darker solution until the two liquids present exactly the same colour, it is very evident that the more highly carburetted steel will furnish the larger quantity of liquid, and that the proportion of the volumes will indicate the relative proportion of colour in the two steels.

If now the composition and content of carbon of one of the steels is known, the absolute percentage of carbon in the other steel may be immediately deduced.

Suppose that 1 grm. of each of two steels (a and b) have been dissolved, and that the volumes of the two solutions brought to the same degree of colouring bear the relation to each other $a : b :: 5 : 7$. Knowing that the steel (a) contains 1 per cent carbon, you at once deduce that the steel (b) contains 1·4 per cent of carbon.

In applying this method of analysis, certain precautions must be taken, which we proceed briefly to point out.

In a cylindrical test-tube, dissolve gradually in the cold 10 centigrammes of wrought-iron, steel, or cast-iron reduced to a fine powder, in 1½ to 5 c.c. of nitric acid of 1·2 specific gravity (about 25° Baumé). The use of nitric acid containing hydrochloric acid must be avoided, because the solution of iron would have a yellow tint.

In proportion as the metal contains more carbon, more nitric acid must be used. After some time, when the chief part of the metal appears to be attacked, place the tube in a water-bath to the depth of about 15 m.m., and warm it to 80° C. In this position, only the lower part of the tube is in contact with the warm water; a movement takes place in the acid which favours its reaction upon the metal; a slight disengagement of carbonic acid from all the particles of carbon may be observed. The operation should always be conducted under the same circumstances as to heat and length of time.

The evolution of gas having ceased (in operating upon steel, the reaction must continue two to three hours), place the tube in a large vase filled with water, to bring the solution always to the same temperature. This precaution is indispensable, because the same liquid is darker when warm than when cold. Afterward, pour off, as exactly as possible, the clear liquid into a graduated burette. Upon the black residue remaining in the tube, pour some drops of nitric acid, and heat carefully over a lamp. If there is no further liberation of gas, the residue consists of nothing but graphite or silica. Cool the new solution, and add it to that which is already in the burette.

The liquid is then diluted with water until its colour corresponds exactly with that of the normal liquid, which latter should be of such a degree of concentration that each cubic centimetre represents 0·0001 grm. of carbon.

If, for instance, this normal liquid is prepared from cast-steel containing exactly 0·85 of one per cent of carbon, 1 decigramme of that steel must be dissolved in 8·5 c.c. of nitric acid; 100 grms. of steel containing 85 centigrammes of carbon would thus be dissolved in 8500 c.c. of the normal solution, 100 c.c. of that solution would represent 1 centigramme of carbon, and, consequently, 1 c.c. of the normal solution would represent 0·0001 grm. of carbon.

The normal solution does not keep, and should be often renewed, since it becomes perceptibly paler even within twenty-four hours. For it, however, may be substituted a dilute alcoholic solution of sugar properly caramelised brought to exactly the same tint; this solution keeps much longer without sensible change.

As 1 grm. of iron cannot readily be dissolved in less than 15 c.c. of nitric acid, it follows that a proportion of carbon less than 0·15 of one per cent* cannot be estimated by means of the normal liquid; but this minimum is seldom found in practice.

If the proportion of carbon exceeds 0·5 of one per cent the ferruginous solution is so concentrated that it has a light greenish tint, which renders its comparison with the normal liquid difficult. In that case, a normal liquid of one-third the strength is prepared by diluting the normal liquid with twice its volume of water; then each cubic centimetre of the liquid represents only one-third of the ten thousandth part of a gramme of carbon. When the proportion of carbon in the specimen to be analysed is very large (as, for instance, in white cast-iron), only 0·5 grm. of the metal must be taken for analysis, and, in that case, half a cubic centimetre of its solution corresponds to a cubic centimetre of the normal solution. If the metal to be analysed contains graphite, the latter must be collected on a filter before the solution is put into the burette.

This method is more exact in proportion as the percentage of carbon is smaller. With an accurate balance, and with suitable arrangements, a great number of determinations of carbon close enough for practice can be effected in a time relatively very short.

All the Bessemer steel made at Edskin, in Sweden, is marked, after hammering (*apres l'étirage*), by figures expressing its hardness, as ascertained by this colour-measuring analysis of Professor Eggertz.

* From the *Bulletin of the Chemical Society of Paris;* translated for the *American Journal of Science* by J. Wharton, Esq.

* O. D. Allen, of the Freedom Iron Works, Pennsylvania, has found it quite practicable, by a modification of this method, to distinguish between iron containing respectively 0·10 and 0·15 of one per cent of carbon.

It is obvious that only burettes of perfectly colourless glass must be used, or, at least, they must all have exactly the same tint.

ON THE

METHODS OF ANALYSIS

AND THE

COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

BY M. GASTON TISSANDIER.

Our object in publishing these memoirs from the *Moniteur Scientifique* is to furnish manufacturers and manufacturing chemists with practical methods of analysing with rapidity and certainty the most important productions of commercial chemistry, and also to give an account of their composition. Special treatises are not wanting containing methods of estimating and separating substances which are subjects of investigation to chemists; but we know of the existence of no collection where the description of a process for analysing such and such a commercial product may be met with. It should be added that the methods here published are not original, and offer nothing in the way of novelty, but are employed by most chemical experts. All that we have done is to make a few trifling modifications in a small number of cases. The efficacy of these processes we can in all cases guarantee by the practice acquired by us three years ago in the *Laboratoire d'Essais et Analyses Chimiques de l'Union National*, where we have already performed more than three thousand experiments of all kinds.

I. On Crude Potashes.

Manufacture of Beet-Root Salts.—Almost all the salts of potash now manufactured are extracted from beet-root, the crude salts or potashes being made by calcining the residues of the evaporation of weak vinegars proceeding from the distillation of molasses. These vinegars were formerly evaporated in copper basins; but the acids developed by too active or imperfect fermentation, or thrown in to hasten decomposition, were found to attack the copper, which soon led to the substitution of wooden vats — an important change, which was first effected by M. Coupier. Not long afterwards, another important step was taken by M. Porion, of Vardrecques, who, in the manufacture of salts, evaporated the vinegar partly by the direct action of fire, and partly by the combustion of the charcoal which exists in the organic substance of the vinegar. The Porion stove, which is now almost universally employed, consists of a long vaulted chamber, having at one end from two to three reverberatory furnaces, and terminating in a chimney, near to which is the tap which turns on the vinegar. This chamber is traversed through its largest extent by a paddle shaft, which agitates the vinegar violently, and causes it to fall in showers into that part of the stove which is subject to the direct action of the flames from the reverberatory furnaces. When the vinegar subjected to this preliminary process is sufficiently evaporated, it is placed upon the sole of the furnaces, where, under the action of the fire and vigorous stirring, it soon assumes a pasty form; after which it quickly takes fire, and becomes itself a source of heat, by means of which fresh quantities of vinegar may be evaporated. Calcination being at an end, the salts are thrown upon the ground, and spread out upon a large space, where a final combustion occurs spontaneously.

The calcination of vinegar residues in the Porion stove requires great intelligence and practice on the part of the operators, on account of the difficulty as well as importance of seizing the proper moment for stopping the calcination. If this latter be carried too far, the potash will melt, thereby producing a substance difficult to lixiviate. The appearance of the melted potash is that of a very hard, close stone, of a light grey colour, veined with white, on concussion giving a dull sound. If, on the contrary, calcination be too soon arrested, the product is a pasty mass, which quickly cools and agglomerates, yielding brown and frothy lixiviums, difficult to treat in refining. The refined products which ensue are never white, but always of a greenish-blue tinge, due to the presence of certain unoxidised or non-volatilised sulphides. The appearance of an imperfectly calcined salt is that of an earthy, brown, close substance, not very hard, tinged throughout with reddish tints, and veined with green and violet lines. If a salt of this kind be wetted, an evolution occurs of the characteristic odour of rotten eggs.

In the preparation of salts, it is most important to remove them from the furnace just at the proper time; and the duration of the calcination varies in accordance with the kind of beet-root employed; thus, when the residue under treatment is that made from Picardy beet-root, which is rich in carbonate of soda, the removal must take place sooner than with residue from the beet-root of Artois.

The disposition of the salts in the heaps where combustion takes place also requires careful superintendence; because, if a heap gets too hot, the potash will run; and if, on the other hand, the temperature does not rise enough, the potash will be imperfectly separated. Salts rich in carbonate of potash are heaped in beds from 30 to 50 centimetres thick; the poorer salts in beds of 2 metres thickness.

A well-made salt ought to present the appearance of a porous stone, very light, friable, and sonorous as pumice-stone; its prevailing colour should be greyish red. Salts contain alkaline carbonates, chlorides, sulphates, substances insoluable in water (charcoal and carbonate of lime); also small quantities of sulphates, and, accidentally, cyanides, sulphides, silicates, ammonia, &c.

Mode of Analysis.—The sample to be analysed should be pounded and sifted. About 30 grms. must be taken and finely pulverised in a porcelain mortar 25 grms. of this impalpable powder are weighed off, and placed in a flask capable of holding 500 grms., and containing about 200 grms. of distilled water; it is then boiled for a quarter of an hour, and left to settle, that the insoluble substances may collect at the bottom of the vessel. The clear lixivium is decanted upon a filter placed on a measuring-glass, gauged to ½ litre. The insoluble substances are again treated with cold water, and so on, for three or four times. Lastly, the insoluble substances are thrown upon the filter, and washed with boiling water until the filtered lixivium occupies exactly the volume of ½ litre. This lixivium, when cool, is stirred until it becomes homogeneous, and divided, by means of a pipette, in the following way:

1. Deduct 100 c. c. (corresponding with 5 grms. of

salts), in order to obtain the alkalimetrical standard; these 100 c. c. must be transferred to a ½ litre flask.

2. Another 100 c. c. to be poured into a ½ litre glass, to estimate the sulphuric acid.

3. Fifty c. c. (equal to 2 grms. 5 decigrammes) of salts to be poured into a stoppered bottle of 250 c. c., to estimate the chlorine.

4. Ten c. c. (equal to 5 decigrammes) to be poured into a porcelain capsule of 200 c. c., to estimate the potassium.

Insoluble Substances.—These must be dried at 100°, removed from the filter, and weighed. By calcining them, and weighing the ashes, the proportion of charcoal and organic matter will be obtained by difference.

Determination of the Alkalimetrical Standard.—A standard liquid must first be prepared containing exactly 100 grms. of sulphuric acid per litre (SO_3HO). For the preparation of this liquid, we refer to chemical treatises, only remarking that it should be carefully tested before use. This may be done either by taking as a standard perfectly dry and pure carbonate of soda, or by estimating the sulphuric acid contained by means of chloride of barium. A graduated alkalimetrical measure is filled with the liquid, which is poured, after the addition of a few drops of litmus solution, into the phial containing the 100 c. c. of lixivium or 5 grms. of salts. When the solution has become purple, it is boiled, in order to remove the carbonic acid, and then recovers its original blue colour. Fresh quantities of sulphuric acid are now added, and it is again boiled. This is repeated until the addition of another drop of standard liquid causes the solution to turn from blue to vinous red, and boiling fails to restore it to blue. By reading the number of divisions corresponding to the volume employed of standard liquid, the alkalimetric standard is obtained: thus, if 44 divisions, or 44 cubic demi-centimetres, are used, the standard will be 44°.

Estimation of Chlorine.—One of the best processes for estimating chlorine in potashes is the employment of a standard silver liquid and a solution of neutral chromate of potash. 47·886 grms. of fused nitrate of silver are first dissolved in distilled water, and then diluted so as to form a liquid 1 litre in quantity. 1 c.c. of this liquid will precipitate 1 centigramme of chlorine. Several cubic centimetres of a saturated solution of chromate of potash are poured into the flask containing 50 c.c. of saline lixivium; and the silver liquid is then added, drop by drop, by means of a measure graduated in tenths of cubic centimetres, until the lixivium, augmented by the chromate of potash, turns red. If 14 c.c. of silver liquid, or 140 divisions, be used, 2·5 grms. of the salts will be found to contain 14 centigrammes of chlorine, reckoned in the summary as chloride of potassium.

The chromate of potash may be dispensed with; in that case, the portion of lixivium in which the chlorine is to be estimated is acidulated by pure nitric acid; the standard silver liquid is poured immediately into it, and the precipitated chloride of silver collected at the bottom of the vessel by quick stirring. The exact quantity of silver necessary to precipitate all the chlorine is easily ascertained; and care must be taken to stir the precipitate whenever fresh drops of the silver liquid are introduced. With practice, this method will be found as quick and accurate as the preceding.

Estimation of Sulphuric Acid.—This may be effected by means of chloride of barium. The 100 c.c. of lixivium are acidulated with pure chlorhydric acid, and chloride of barium is added. The precipitated sulphate of baryta is allowed to settle for twelve hours, and need then only be collected on a filter, washed with boiling water, and weighed after desiccation and calcination.

Estimation of Potassium.—By means of bichloride of platinum, the potassium is deposited under the form of chloroplatinate of potash. The 100 c.c. of lixivium corresponding to the 5 centigrammes of salts are acidulated with pure chlorhydric acid; an excess of bichloride of platinum dissolved in water is added in the same capsule, and the whole is then evaporated almost to dryness in a water-bath; at the same time it is very important not to desiccate the precipitate, which, when taken out of the water-bath, should be moistened with at least 1 c.c. of liquid. On attaining this point, it is washed by decantation with ethereal alcohol (4 volumes of alcohol at 40°, and 1 of ordinary sulphuric ether), and thrown upon a small filter. It is again washed upon the filter with a small quantity of ethereal alcohol, dried at 100° in the water-bath, carefully removed from the filter, and weighed in a sensitive balance. It answers to the formula $KCl,PtCl_2$, and the amount of potassium contained in it may be easily calculated. Some chemists do not filter the chloroplatinate of potassium, but wash it by decantation in a vessel of Bohemian glass, where it is evaporated, and dry it in the same vessel in the water-bath. The very light precipitating vessel is tared before the operation, and, by weighing it together with the contained precipitate, the difference obtained is the weight of the latter. In treatises on chemistry, the chloroplatinate of potash is generally recommended to be filtered on a tared double filter—an unnecessary precaution with the proportions here mentioned. When the quantity of salts employed is 5 decigrammes, the precipitate obtained always weighs about 1 grm.; and the amount of substances which adhere to the paper is quite insignificant. To effect this process under good conditions, the best plan is to use a standard solution of bichloride of platinum, in order to be certain beforehand of using neither a too weak nor too powerful reagent. The platinum may be dissolved in the state of sponge by means of aqua regia, in the proportion of 60 grms. per litre, and diluted with water after evaporation: 10 c.c. of this liquid will be required to estimate the potassium.

Moisture.—The moisture contained in a salt may be estimated by drying 5 grms. on a stove, heated to 120°, failing which a small closed tube may be used, into which 5 grms. of salts are placed, and dried over a jet of gas, the water condensed at the upper end of the tube being soaked up with a plug of filtering-paper. The tube is weighed empty, and again with the desiccated portion of the salt, and the difference given is the proportion of water.

Calculation of the Analysis.—The estimated chlorine is transformed into chloride of potassium, the sulphuric acid into sulphate of potash. The quantity of potassium contained in the chloride and sulphate is calculated, and then deducted from the total of potassium yielded by the chloroplatinate. The excess of potassium is transformed into carbonate of potash. The standard corresponding with the carbonate of potash is calculated, and subtracted from the total s
and the excess of the standard is tra

bonate of soda. The form of the analysis is drawn up in the manner indicated below.

Phosphates are sometimes contained in salts, but in small quantities, and, in analyses for purposes of manufacture, it is generally useless to pay any attention to them.

The mode of analysis here described gives very precise results; and, when practice has been acquired, the separation of potassium and sodium occurs with great exactitude. It has been proposed to separate the potassium by means of tartaric acid; but we believe that this process would be neither so practical, nor so rigorously exact as the one we have described, whilst with the *natrometer* its results would be merely approximative.

In the course of three years, more than 1000 specimens of salts and refined potashes have been analysed by us, an example of which we subjoin below.

COMPOSITION OF BEET-ROOT SALTS.

Substances estimated.	From l'Aisne (1).	From the Somme (2).	From the environs of Lille (Nord).	From the environs of Lille.	From l'Aisne (3).	From the Nord.
	I.	II.	III.	IV.	V.	VI.
Moisture	4·00	2·59	3·48	7·72	2·47	1·19
Insoluble matter	13·50	10·61	14·02	12·08	11·60	13·11
Chloride of potassium	18·86	15·10	20·48	33·76	10·28	29·82
Sulphate of potash	5·71	11·62	11·20	5·75	3·83	2·97
Carbonate of potash	44·28	44·70	24·72	17·00	53·50	36·50
Carbonate of soda	13·48	15·28	26·01	23·50	8·18	16·20
Non-estimated and loss	0·17	0·10	0·09	0·19	0·14	0·21
Total	100·00	100·00	100·00	100·00	100·00	100·00

(1). Product manufactured by the Societé des Usines de Montjean et Channy; MM. Bayard de la Vingtrie, Frères, et Cie.

(2). Ham Distillery (Somme), MM. Hurbain-Désormeaux.

(3). MM. Gunguièz et Cie., Bucy-le-Long, near Soissons.

Specimens No. 1 and 2 may be considered as types of salts of good quality. No. 5 is one of the richest with which we have met, and Nos. 3 and 4 are the poorest. The composition of the crude potashes varies extremely, as is self-evident, each constituent element occurring in different proportions in the various examples. We have been asked by some chemists why the composition of salts has been thus formularised, and how we could prove that they did not contain, say, for instance, chloride of sodium. Setting aside the established custom in all commercial refineries of combining the elements in the mode we have adopted, our answer is, that refining itself proves that this formula points out the true composition of the salts. If the refining be well conducted, all the salts indicated by this formula will be obtained, and in almost exactly the same proportions.

Potashes Derived from the Grease of Wool.—Before terminating our account of salts, a few words may be added relative to the potashes derived from grease extracted from wool-washings. The potashes made from grease analysed by us were produced by M. Thery-Disière, who is at the head of an important manufactory at Verviers (Liège), and who was the first to baths for the purpose of steeping wool, which was, always thrown into the river. Here is the n of one of these potashes:—

POTASH OF WOOL GREASE.

	I.	II.	III.
Moisture	2·83	1·20	1·05
Insoluble matter	11·98	5·28	11 19
Chloride of potassium	5·88	6·12	7·04
Sulphate of potash	2·48	3·03	3·33
Carbonate of potash	71·52	79·01	72·25
Carbonate of soda	4·96	5·15	5·14
Non-estimated and loss.	0·35	0·21	5·14
	100·00	100·00	100·00

Potashes extracted from wool grease are produced in several manufactories in France, and constitute an excellennt product, rich in carbonate of potash; but an important progress in this branch of manufacture yet remains to be realised, viz., the diminution, or even complete removal, of insoluble matter without recourse to refining.

REFINED POTASHES.

Refining the Salts.—The salts are broken into fragments the size of an egg, and lixiviated in water. The lixivium should mark from 20° to 25° on the Beaumé areometer; it is passed into cauldrons, where, by successive evaporations, crystallisations, and solutions, the separation of the salts is effected.

In the first set of cauldrons, the lixiviate is evaporated until it marks 40° on the Beaumé areometer; at this density, most of the sulphate of potash is precipitated. The liquid is left to settle, and decanted into crystallising pans, where the greater part of the chloride of potassium crystallises when quite cold.

The mother liquor is evaporated in the second set of cauldrons until it marks 45°, during which process it precipitates carbonate of soda. After settling, the lixiviate is again passed into the crystallising pans, where, on cooling, a new deposition of chloride of potassium takes place. The lixivium is again heated in the third set of cauldrons, and rendered sufficiently concentrated to mark either 50, 51, 52, or 53 areometric degrees. Carbonate of soda is still deposited; the liquid in the crystallising pans, when cool, still precipitates chloride of potassium, and, when evaporated to dryness, yields commercial refined potash, generally containing from 78 to 82 per cent of carbonate of potash. In order to obtain potashes refined to a still higher standard, these are dissolved at 80°, and the solution evaporated to 61 or 63 areometric degrees. Carbonate of soda is deposited, and the liquid obtained, when evaporated and calcined, yields potashes containing from 88 to 94 per cent of carbonate of potash.

Sulphate of Potash.—It has been shown that the greater part of the sulphate of potash contained in the salts was deposited during the first evaporation of the lixivium. This salt, polluted in the first instance by the impurities of the lixivium, contains, besides the alkaline carbonates, chloride of potassium. By means of rakes, the salt is taken up as it precipitates, placed to drain in vessels of perforated sheet iron, dissolved, and subjected to a fresh crystallisation. Commercial sulphate of potash is thus obtained.

Chloride of Potassium.—The chloride of potassium successively deposited during the different phases of evaporation of the lixivium is left to drain, and, when deprived of the liquid which moistens it, is saleable. After the second or third cooling, it is not, however, sufficiently pure to be introduced into trade, and must be collected and restored to the first set of cauldrons, there to be operated upon anew.

Carbonate of Soda.—The carbonate of soda produced by evaporation of the lixivium is purified after desiccation by means of successive solutions and crystallisations, repeated two or three times. The soda-salt thus obtained furnishes, after calcination, commercial white soda.

It is, of course, understood that these evaporations never produce salts in a state of complete purity, and that all products thus obtained are mingled more or less with other substances. Sulphate and chloride of potassium and carbonate of soda are manufactured by other processes than those we have described. On this subject a few words will be said when discussing more especially these different salts. We will at present confine ourselves to an examination of the composition of refined potash (carbonate of potash).

Method of Analysis and Composition of Refined Potash.

The analysis of refined potash is effected in a precisely similar manner to that of crude potash, except that it is more rapid, on account of the non-necessity of separating the insoluble substances, which occur in only the smallest proportions.

Twenty-five grms. of refined and pulverised potash are dissolved by decantation in a flask, and the obtained lixivium is diluted to the volume of 500 c.c. Decant 100 c.c. to obtain the standard, 100 c.c. to estimate the sulphate, 50 c.c. to determine the proportion of chlorine, and 10 c.c. to estimate the potassium, by means of bichloride of platinum. The moisture is estimated by heating the potash salt to a red heat in a platinum crucible. The analytical results given below may be considered as representative types of the different qualities of commercial refined potashes. As in the case of the beet-root salts, we give the names of the manufactories whence the specimens were obtained; and we here desire to thank those manufacturers who, while supplying all necessary information, have kindly authorised us to publish the composition of their products.

These results will show that commercial refined potashes contain from 69 to 93 per cent of carbonate of potash. It should be added that analyses Nos. 8 and 9 were performed upon carbonate of potassium from Stassfurt, according to the method of M. Leblanc.

Substances estimated.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
Moisture and insoluble ...	3·05	0·80	0·61	0·68	2·00	0·38	5·66	0·21	0·42	15·56
Chloride of potassium	3·21	3·35	2·61	3·22	3·41	3·41	4·68	5·81	4·00	1·47
Sulphate of potash.....	2·31	1·48	0·80	2·00	4·62	1·41	2·00	3·45	2·10	0 11
Carbonate of potash.....	78·10	81·22	91·25	91·88	87·51	92·87	69 25	82·68	89·37	79·86
Carbonate of soda	13·33	13·15	4·73	2·22	2·46	1·93	18·41	7 85	4·11	3·00
Total.....	100·00	100·00	100·00	100·00	100 00	100·00	100·00	100·00	100·00	100·00
	Corbehem Distillery, near Douai; M. A. Lefebvre.			MM. Tillog-Delaune and Co., Courrières (Pas de Calais).			X	MM. Vorster et Gruneberg, Cologne (Prussia).		Hydrated potash; maker unknown.

Chlorides of Potassium.

Commercial chlorides of potassium, or muriates of potash, contain sulphates, and frequently alkaline carbonates also; in certain cases a more or less considerable proportion of chloride of sodium is also found in them.

Method of Analysis.—Weigh 25 grammes of the muriate of potash to be tested, and dissolve them in a beaker; filter the solution to separate the insoluble matters, which usually occur only in very small proportion, and dilute it with water to the volume of ½ a litre.

Alkalimetric Standard.—This does not generally exceed 1° or 2°; for obtaining it, decant 100 c.c., corresponding to 5 grammes: ascertaining previously that the solution is alkaline, for it is possible that the muriate may not contain any alkaline carbonates.

Sulphuric Acid.—The sulphuric acid is estimated in 100 c.c. (5 grammes) by means of chloride of barium.

Chlorine.—The estimation of the chlorine is of great importance, and should be rigorously exact: take 10 c. c. of the filtered liquid tared to ½ a litre, and determine the amount of chlorine by means of a standard silver liquid. For greater exactness, it is a good plan to verify this estimation by directly weighing the chloride of silver precipitated in another experiment. Measure 10 c.c. (0·50 gr.) of the solution of muriate, and transfer them by means of a pipette into a beaker holding 500 c.c.; add a large quantity of boiling water, acidulate it with pure nitric acid, and precipitate the chlorine by a slight excess of nitrate of silver. The estimation previously made by means of the standard solution allows the quantity of nitrate of silver required to be calculated, so that the excess may not be great. The precipitate is well stirred with a glass rod, and the warm liquid settles so well that it is possible to wash the precipitate of chloride of silver by decantation with boiling water. When the washing water is not clouded on the addition of a drop of chlorhydric acid, it is thrown on a small filter, left to drain, and dried at 100°.

The desiccated precipitate is detached from the filter, which is calcined in a small tared porcelain capsule, and when the paper is burnt, the chloride of silver precipitate must be added and partially melted; it is then cooled, and the capsule weighed together with the chloride of silver; the weight of the precipitate is thus obtained by difference. The chloride of silver adheres closely to the capsule. In order to remove it, throw the whole into a glass, and place on it a piece of zinc, sulphuric acid, and water; the chloride of silver, partially reduced, will then separate from the capsule.

Potassium.—The estimation of potassium is effected in the same way as in the case of crude salts (see CHEMICAL NEWS, vol. xx., p. 73, *Am. Rept., Oct.*, '69, *p.* 207), by means of bichloride of platinum, working upon 10 c.c. (0·50 grms.)

Water.—The proportion of water is ascertained by heating, in a platinum crucible, a given weight of the muriate to be tested. A closed tube is still better, as it allows the loss from projections arising from the deflagrations of the salt to be more easily avoided.

Calculation of the Analysis.—Part of the estima-

ted potassium is combined with the sulphuric acid contained in the sulphate. If the excess of potassium is sufficient to combine with the whole of the chlorine, the latter is transformed into chloride of potassium; if not, the quantity of chlorine necessary to form chloride of potassium with the remaining potassium is calculated, and the excess of chlorine reckoned as chloride of sodium.

COMPOSITION OF COMMERCIAL MURIATES.

1. *Muriates containing Alkaline Carbonates.*

Substances estimated.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Moisture	4·27	6·68	5.00	1·01	1·38	3·69	6.35	15 06
Insoluble matter	0·32	0·22	0·10	0·18	0·28	0·41	0·90	0·09
Sulphate of potash	12·31	9·45	12·31	5·50	4·01	14·18	11·81	11·62
Chloride of potassium	79·80	80·00	77·20	92·39	93·52	80·92	75·01	59·41
Carbonate of potash	1·00	3·25	3·10	0·92	0·61	0·49	3·28	13·82
Carbonate of soda	2·10	—	2·01		—	—	2·13	
Non-estimated and loss	0·20	0·40	0·28	—	0·20	0·31	0·52	—
Total	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
	MM. Vorster and Grüneberg, at Cologne.				M. P. Rohée, at Bordeaux.		M. A. Lefebvre, at Corbehem, near Douai.	

2. *Muriates containing Chloride of Sodium.*

Matters estimated.	I.	II.
Moisture	3·09	1·50
Insoluble substances	0·11	0·20
Sulphate of potash	0·81	4·61
Chloride of potassium	80·15	78·40
Chloride of sodium	15·01	14·09
Carbonate of soda	0·72	1·12
Non-estimated and loss	0 11	0·08
Total	100·00	100·00
	MM. Campion and Theroulde, at Granville.	

N. B. These sulphates proceed from a manufacture of iodine from kelp.

3. *Muriates containing neither Chloride of Sodium nor Carbonates.*

Substances estimated.	I.	II.	III.
Moisture	1·20	3·63	3·50
Insoluble matter	0·31	0·21	0·30
Sulphate of potash	6 90	11·86	4·55
Chloride of potassium	91·50	84·20	91·65
Non-estimated and loss.	0·09	0·10	—
Total	100·00	100·00	100·00
		M. Paisant, jun., at Pont-l'Abbé (Finisterre).	

Chloride of potassium is obtained, as has been shown, from the beet-root salts; it is also extracted in abundant quantities from the ash of seaweed. The newly-discovered deposit at Stassfurt yields considerable quantities; and large kidney-shaped pieces of pure chloride of potassium have been found in abundance in the midst of that vast salt mass. We have repeatedly analysed this natural chloride of potassium (called by the Germans sylvin), and have never discovered more than 1-10th of foreign matter. Every sample which we examined contained from 80 to 99 per cent of chloride of potassium. This is a highly important fact; and it is well known that the influence of the exportation of the Stassfurt products is already making itself felt in the manufacture of potashes.

(To be continued).

PRELIMINARY NOTE ON

THE PRODUCTS OF THE DESTRUCTIVE DISTILLATION OF RESIN.

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I HAVE been engaged for several years in the investigation of the distillation products of resin. The subject having proved one of great extent and complexity, it was not my intention to have made any part of it public until it was more complete than it is at the present moment, but the recent appearance of a similar investigation by Mr. Tichborne * has induced me to alter this intention and to publish my results, especially as some of them differ from those which he has obtained.

When common colophony is distilled, the first product is a small quantity of a volatile oil commonly known as "rosin spirit," consisting of some products of decomposition of the resin contaminated with a portion of the essential oil originally existing in the turpentine. When this is separated, an oil is obtained which becomes more and more viscid as the distillation proceeds, and shows a gradually increasing blue fluorescence as the temperature rises, and at last a small quantity of charcoal is left in the still. When this crude resin oil is rectified, the first product is a "rosin spirit," larger in quantity and somewhat different in smell from that obtained in the first distillation. This is followed by a mixture of thick oils of high boiling point, and the last product, if kept separate, acquires, on cooling, the consistency of soft butter, or rather of oil and butter. When this is exposed to a freezing mixture and expressed, a solid crystalline substance is left on the cloth, which, when purified, proves to be the metanaphthaline or retisterene, of Pelletier and Walter.

My investigations hitherto have been mainly confined to the spirit obtained in rectifying the crude resin oil. When this is submitted to a systematic fractionated distillation, it splits up into a variety of oils, and after seven or eight rectifications, fractions are obtained at all temperatures, from 70°, C. up to 400°, the latter being of course portions of the less volatile oils which passed over at the first rectification.

The fractions boiling between 125° and 150° deposit a crystalline substance, which is obviously an oxidation

* CHEMICAL NEWS, vol. XX., p. 38 (*Am. Repr., Sept.*, '69, p. 147).

product, and increases in quantity when the oil is preserved in partially filled bottles. This substance is Mr. Tichborne's colophonine. It is soluble in water, ether, and alcohol, and is deposited from the hot solutions in long needle-shaped crystals, which fuse at 106° and sublime easily at a higher temperature. Their smell is aromatic, and they have a warm and somewhat pungent taste. They were purified by expression, exposure to the air until the oil attached to them had evaporated, and then subliming repeatedly. The results of combustion were as follows:—

(I.) 0·425 gramme gave 1·004 CO_2 and 0·424 H_2O.
(II.) 0·2225 gramme gave 0·526 CO_2 and 0·225 H_2O.

	I.	II.	Calculation.		
Carbon	64·43	64·47	64·61	C_7	84
Hydrogen	11·09	11·24	10·77	H_{14}	14
Oxygen			24·62	O_2	32
			100·00		130

This corresponds completely with the empirical formula $C_7H_{14}O_2$ which bears a simple relation to terebic acid, $C_7H_{10}O_4$. I have endeavoured, but as yet without success, to convert this substance into terebic acid by means of oxidising agents. By strong nitric acid it is converted into oxalic acid, with more dilute acid a resin is produced, but I have not obtained it in sufficient quantity to admit of any process of purification being applied to it. Not having analysed the crystals of this substance deposited from water, I failed to detect Mr. Tichborne's hydrate of colophonine, but the composition he gives for it is not altogether inconsistent with my formula, for a hydrate $C_7H_{14}O_2 + H_2O$ would give—

Carbon	56·75
Hydrogen	10·81

The oils contained in resin spirit are very complex, and consist of a mixture of hydrocarbons, the investigation of which is still quite incomplete. The most volatile fraction, which was very small and boiled between 70° and 80°, contained a volatile acid, apparently acetic acid, which gave abundant white fumes with ammonia. After separation of this acid by washing with water and drying, the oil gave—

Carbon	84·62
Hydrogen	13·71

Though the oil obviously contains oxygen, these numbers approximate to the composition of an olefiant, and its vapour density was 3·257, agreeing sufficiently with 3·386, which is the theoretical number for heptylene. The oil is probably a mixture of this substance with some oxygenated product, but the quantity at my disposal did not permit of any process of separation being employed.

At the temperature of 107° a larger quantity of oil was obtained, also containing oxygen. It gave, on combustion—

	I.	II.
Carbon	85·90	86·44
Hydrogen	12·75	12·97
	98·65	99·41

in which the carbon agrees with that of an olefiant, although the hydrogen is deficient. As far as analysis is concerned, the oil appears to be homogeneous, for, on rectifying it and separating the first few drops and the last few drops of the distillate, they were found, on combustion, to give identical results. The action of reagents, however, leads to an opposite conclusion. When digested for some time at 220° with strong hydriodic acid, it is converted into a black oil heavier than water. This, after being washed with potash and dried, yielded on distlilation two oils, one boiling at about 177°, which contains iodine, is partially decomposed by distillation, and for which no formula could be obtained, and a non-iodized oil, very viscous, with green fluorescence, and boiling at 290°. On combustion it gave the following results:—

	Experiment.	Calculation.		
Carbon	87·94	88·24	C_{10}	120
Hydrogen	12·19	17·76	H_{16}	16
	100·0	00·00		136

It is therefore a terpene apparently corresponding with the colophene or metaterpene of Berthelot.

Of the less volatile oils, I have as yet examined only one boiling at 157°, and another boiling at a higher temperature. The former is an oxygenated oil, with a specific gravity of 0·853. The results of its analyses in the first instance approximated to those of terpinol, with which, however, it is only isomeric and not identical. But some results afterwards obtained lead me to suspect that it may be a product of hydration of a terpene existing in the crude oil. When treated with sulphuric acid, heat is evolved, and the oil, after being separated from the acid and purified by distillation, has exactly the smell and composition of terebene. The products at higher boiling points appear to be terpenes, but they give no solid hydrochlorates, and their separation presents difficulties which I have not hitherto been able to overcome.

I trust I may be able at some future period to throw further light on the constitution of these substances; my investigation of which must be considered for the present as entirely preliminary.

ON THE

ESTIMATION OF THE SO-CALLED PRECIPITATED PHOSPHATES IN MANURES,

AND THE

ESTIMATION OF SOLUBLE PHOSPHATES GENERALLY.

BY FRANCIS SUTTON, F.C.S., NORWICH.

The difficulty presented by this subject has lately been discussed in this journal from two points of view, namely, that of the manure manufacturer and the professional analyst.

Any one who knows anything of the matter must certainly feel, with the manufacturer, that it is a real grievance to have expended time and money in producing soluble phosphate which, owing to this reducing action, is valued at only about one-third the price it ought to sell for.

Again, on the other hand, the analyst is asked to say how much phosphate of lime soluble in water is present in a particular sample of manure, and his duty is plainly to treat such a sample with water only, and state the percentage of phosphate therein.

The manufacturer says, I believe the recently-reduced phosphate is quite as effectual in action as the soluble phosphate, because I am told by good authorities that, so soon as soluble phosphates come in contact with the soil, they are rendered insoluble, and, therefore, why

should not my recently-precipitated phosphates be just as valuable as the soluble phosphates? The only reply that can be made to this is that the analyst, unless he can find a reliable process for estimating recently-reduced phosphates, must consider and value them solely as insoluble phosphates. It has been proposed to use citric acid, oxalic acid, or oxalate of ammonia for the purpose of rendering these phosphates soluble, in order that they may be estimated and valued at a higher price than ordinary insoluble phosphates.

If it can be shown that any of these reagents will affect such a material as Cambridge coprolite, and render it soluble in water, it is manifest that such aids cannot be depended upon for the purpose required.

This seems to have been pretty well settled by the experiments of Mr. Hughes; but the results obtained by him have been cavilled at by one of your correspondents ("Fair Play") as being conducted in an improper way. As I am situated in the heart of a large manure-consuming district, and continually estimating phosphates, it has occurred to me to extend these experiments somewhat further, and I think the result will show that no real dependence can possibly be placed upon any of the hitherto-suggested plans for determining these reduced phosphates.

The experiments were made upon two substances, namely, a mineral superphosphate which originally contained about 23 per cent of soluble phosphates (calculated as bone-earth), but which, at the time of the first experiment, yielded only between 17 and 18 per cent, together with about 10 per cent of insoluble; the other substance was raw Cambridge coprolite, containing about 56 per cent of insoluble phosphate of lime. All the determinations were made by the acetate of uranium process, in the presence of a slight excess of free acetic acid.

1. One grm. superphosphate, treated first with cold and afterwards with hot water, yielded 17·7 per cent soluble phosphate.

2. One grm. finely-ground coprolite, treated precisely in same manner (as might be expected), gave no soluble phosphate.

3. Residue of No. 1, boiled with 100 c.c. water and 4 c.c. strong acetic acid, yielded 2·3 per cent soluble phosphate.

4. One grm. coprolite, with same proportions of water and acetic acid, gave 4·8 per cent soluble.

5. One grm. of the superphosphate, heated with equal parts of acetic acid and water, gave 19·5 per cent soluble.

6. One grm. coprolite, treated in the same manner, gave 9·9 per cent soluble.

7. One grm. coprolite, heated with 1 grm. citric acid and 100 c.c. water, gave 10·4 per cent soluble.

8. One grm. coprolite, with same quantities of tartaric acid and water, gave 10·8 per cent soluble.

9. One grm. of same superphosphate, digested in the cold with ½ litre of water for twelve hours, gave 14·8 per cent soluble.

10. One grm. of the same superphosphate, but some five or six weeks older, was put into a vessel with ½ a litre of water, and charged with 10 volumes of carbonic acid for five hours; the yield was 13·8 per cent soluble.

11. One grm. coprolite was treated precisely in same manner, and gave slight traces only of soluble phosphate.

12. 2·5 grms. same superphosphate, digested in the cold with 2·5 grms. oxalate of ammonia in ½ litre of water for twelve hours, gave 16·0 per cent soluble.

13. 2·5 grms. coprolite, digested in the cold with same weight of oxalate in ½ litre of water for twelve hours, gave no soluble phosphate.

14. 2·5 grms. superphosphate and 2·5 grms. oxalate of ammonia were mixed with ½ litre water, and heated on the water bath one hour; the yield was 17·1 per cent.

15. One grm. superphosphate, with 1 grm. oxalate, were mixed with 50 c.c. water, and digested half an hour on water-bath; the yield was 19·4 per cent soluble.

16. Same weights of both were mixed with 50 c.c. water, and digested in the cold twelve hours; the yield was 17·6 per cent soluble.

17. One grm. superphosphate, with 1 grm. oxalate, were mixed with 50 c.c. water, and boiled ten minutes; the yield was 22·6 per cent soluble.

18. One grm. coprolite, boiled for same time in 50 c.c. water and 1 grm. oxalate, gave 10·8 per cent soluble.

The results of these experiments are, in some respects, anomalous, but a little consideration will probably throw some light on the matter.

The superphosphate here examined contained considerable quantities both of iron and alumina; and it seems that it is only such phosphates that are, to any considerable extent, liable to this reduction. The true explanation of their action in this respect I cannot pretend to give, nor have I heard of any being given by others; it is, however, well known that raw phosphates containing these substances make very soft and pasty manures, which, before they can be rendered marketable, must be dried by the addition of some absorbing substance which, as it removes the constitutional water from the iron or alumina phosphates, converts them into some basic form which is not soluble in plain water. If it be the case that iron or alumina, or both, are at the bottom of this matter, this explains the slight effect which acetic acid has upon the residue of this particular superphosphate after exhaustion with water (see experiments 3 and 5); while the plain coprolite, containing only slight traces of iron or alumina, yields double the percentage of soluble phosphate under the same treatment in experiment 4, and about five times as much in experiment 6.

With regard to the effect which oxalate of ammonia has upon reduced phosphates, it appears that no very great increase of soluble phosphate is obtained by dilute solutions in the cold, or upon coprolite; but when a boiling heat is used, and the solution concentrated, a considerable yield is obtained in the case of the reduced phosphates, and as much as 10·8 per cent from the coprolite.

It does, therefore, appear that, where a superphosphate contains the so-called reduced phosphates, their amount may pretty nearly be found by the use of oxalate of ammonia in a boiling solution. But it is quite another question whether the phosphates so recovered are as valuable as if they were soluble in water; at any rate, carbonic acid, under considerable pressure, has no more effect upon them than it has upon raw coprolite. The thing which does affect them, namely, oxalic acid, acts upon hard raw coprolite still more; and this does not favour the supposition that they are as valuable as if they had never been reduced.

Again, suppose a manufacturer chooses to mix off some tolerably pure form of insoluble phosphate with a superphosphate liable to reduction; the analyst who used the oxalate process for estimation would, probably, report several per cents of soluble phosphate in the manure which had never been in the soluble state at all,

and the farmer would be asked to pay about three times as much for such phosphates as he might have bought them for in the form of coprolite.

Under such circumstances as these, it, therefore, seems that the duty of the analyst is plainly to state the absolute truth—namely, that such a sample of manure contains so much phosphate of lime soluble in water—and there leave it. I repeat that this is a hardship to the maker, in many cases; but I am not certain that it is necessary for him to incur this risk.

I would now say a word or two relative to the method of estimating soluble phosphates; the stigma which has been brought upon professional chemists in general by the fact that some well-known professional men invariably give high results, while others, also, invariably give low ones, is considerable, and ought, if possible, to be removed.

This discrepancy may, in most cases, be accounted for by the process adopted in determining the phosphates; and, in order to remedy this evil, I would recommend the universal use of one process only, granting that a good and reliable process can be found.

All chemists are aware of the good effect which has resulted from the adoption of this system in silver assaying by the wet method and others of like nature; and I see no reason why it should not be adopted in the matter of soluble phosphates. There may, of course, be a difference of opinion as to what process shall be adopted, but I know of none so reliable for manures of all descriptions (for soluble phosphates), as the uranium process by weight (fully described by me in this journal of February 4th and 18th, 1860). A very large number of analyses made in my laboratory since that time, and tested by every conceivable comparison, have brought the conviction that no other process is, at the same time, so short and so exact, and is quite available, without modification, in the presence of iron or alumina phosphates usually found in some samples of manure. An analysis can be begun and completed within three hours; and, of course, a series may be carried on at one and the same time, if a sufficient number of vessels are at hand. The objection against the process, on the ground of expense, amounts to nothing, since the whole of the uranium can be recovered again for repeated use.

DETECTION OF POTASH AND SODA BY BLOWPIPE VESICULATION.

The following letter and list of experiments has been forwarded by Capt. W. A. Ross, R.A., to Professor Theodore von Richter, Head of the Royal College of Freiburg, and also to us for publication in the Chemical News:—

Simla, India, June 17th, 1869.

Dear Sir,—In accordance with the request contained in your letter of the 1st of January, 1868, to my address at Woolwich, to be informed of the result of my further labours in the matter of blowpipe vesiculation discovered by me, I have the pleasure now to communicate the following:—On arriving here in April, the weather being very warm and dry, and an aneroid barometer compensated for heat standing only at 22·80°, I made some borax vesicles of KOHO and CaCl, and other of the most deliquescent salts I had, none of which, to my surprise, either deliquesced or showed the least sign of crystallisation. They remained unchanged until the 8th of June, when very heavy rain fell the whole day and night. Next morning the potash vesicle had partly deliquesced, and the rest were covered with crystals. From this fact I ascertained that the vesicular crystallisations of borax discovered by me are all superposed, or formed from the hygrometric moisture of the air, and not pyrogenous, or formed from the hot borax on cooling, like those mentioned by Berzelius (pp. 64, 190, 214, &c., of the American Translation, Boston, 1845), Rose of Berlin, and other writers. As it appeared to me that the moist atmosphere could only act with uniformity on uniformly composed substances presented to it for crystallisation, I strove to attain something like uniformity by measuring 50 milligrammes of borax for each bead, taking up as near as possible an equal quantity in each case of the substance to be examined. I found this a troublesome process, and hit upon a far easier and equally exact method—by measuring the bead after it had cooled, by slipping over it a glass tube of the diameter of 5° on the lead measure, filing a shoulder on the top of the platinum wire-holder to allow the tube to stand upright over the wire, and then seeing with the magnifying glass how far the sides of the bead (placed with the wire next the eye) were from touching the sides of the tube. I reflected, however, that borax, being a compound salt, could scarcely be expected to give uniform results chemically, either as regards crystallisation or any other operation, and connecting the fact in my mind that alkalies and alkaline earths always give a cloudiness to vesicles of borax in moist weather with the other facts—(1) that the "boron diamond" can only be attacked by the fused hydrates of the alkalies; and (2) that alkaline borates are freely soluble, while those of the other bases are either insoluble or very sparingly so—I determined to operate if possible on pure boracic acid. I was much pleased to find that substance easily blown into vesicles (having expected the contrary), as it is very viscid when the HO and air bubbles are expelled from it, and I found that its vesicles, being thinner than those of borax, invariably possessed a most brilliant iridescence. But the most useful feature to me was the fact of their clouding over a few seconds after formation, with a delicate blue white film upon which the iridescent colours, gleaming beneath, bestowed a beautiful opaline or mother-of-pearl lustre which I have called "opalescence." I immediately saw that as the borax vesicle is clear and the boracic acid one opaline, a valuable and sure means of detecting the presence of soda, at least in the proportion in which it enters into the composition of borax, is thus afforded, for that amount of soda in the subject of analysis would of course combine with the BO_3 forming a boracic acid (or clear) vesicle. I will not fatigue you with details of the experiments I made, 48 of which I have the pleasure to enclose. You will be able to draw just conclusions from them or others repeated far better than I can possibly do, but I may venture to state that my object hitherto has been almost exclusively confined to a means of isolating, by this method, potash from soda, the blowpipe flame and oxide of nickel tests being, as you are aware, almost worthless, and that, by the wet analyses, a long, tedious, and difficult operation. Without troubling you with details (which will be found in the experiments) I ventured to conclude—

1st. That soda and fluor spar (CaF) interfere with the opalescence of BO_3 vesicles.

2nd. That potash does not interfere with it.

3rd. That chlorine increases it both as to quickness of appearance and intensity.

4th. That CO_2 causes it to appear after a time weakly, even in the presence of soda.

I regret I have no pure or caustic soda to operate

with, nor can I obtain it nearer than Calcutta. Experiments 17 and 20 show that 10 to 13 c.c. of potash Alaunstein can be detected by this method in presence of 53Fl and 32 soda (in kryolite), and, on the other hand, experiment 48 shows that, without soda as a constituent, potash alone fails to neutralize the effect of CaF in preventing the opalescence of vesicles of boracic acid.

I have, as you will see, attempted scarcely anything but the two alkalies—the acids and metals, &c., remaining for future examination. It was easy enough to distinguish by this method between potash and soda in pure salts, but I found it more difficult when applied to traces of those alkalies in silicates; still, I discovered, as you will see, traces of potash by this means in the soda minerals, "albite, analcine, and labradorite," supplied me from Freiberg, while kryolite showed not a trace, and when artificially supplied with KO from Alaunstein, immediately showed a strong trace of that alkali.

Besides being (I hope) found to be most useful in detecting soda and potash in minerals, and of making BO_3 and CaF betray each other, these boracic acid vesicles form the most delicate hygrometers possible, clouding over with a rapidity proportional to the amount of moisture contained in the atmosphere. If the air is so very dry that even boracic acid vesicles take some time to opalesce, the addition of chlorine will make them still more sensitive, and if the air is very moist, that of CaF far less so, until absolute insensibility (or transparency) is attained. I regret that the departure to-day of the mail prevents my saying more at present on this interesting subject. Pray let me know what result your experiments on the subject give, and believe me, yours with great respect,

W. A. Ross.

EXPERIMENTS IN VESICULATION WITH BORACIC ACID, June 13, 1869.

(Bar. 22·70; Ther. 82; Air, very dry.)

1. BO_3+KOHO.	Opalesced in four minutes.
2. BO_3+$NaOCO_2$.	Remained quite clear for hours.
3. BO_3+$KOCO_2$.	Opalesced in fifteen minutes.
4*a*. BO_3+NaCl.—At first I took a large quantity of BO_3, and could not take enough Na from the NaCl to satisfy it, as the bead dropped off.	The BO_3 therefore apparently seized upon a part of the Cl (which came off in thick fumes) and the vesicle clouded over the moment it was taken from the flame.
4*b*. Tried NaCl again, in large quantity, with very little BO_3.	Fumes of Cl, when stopped vesicle made; remained quite clear ever since up to to-day (June 17).
5. BO_3 + MoS.—The native sulphide.	Clouded (not opalesced) in quarter of an hour; afterwards crystals formed exactly like leopards' spots.
6. Tried 4*a* and 1 near the flame of spirit lamp.	Opalescence vanished immediately, leaving a clear dry vesicle exactly like the volatilisation of the sublimate of arsenic from charcoal before the blowpipe.
7. Alaunstein.	Opalesced in fifteen minutes.
8. Kryolite.	Remained quite clear to date; vesicle much less fragile and iridescent than those of BO_3, and bead more fluid.
9. Adular.	Opalesced slightly in twenty minutes.
10. Albite.	Faint opalescence after quarter of an hour.
11. SiO_3 powdered.	The SiO_3 remained undissolved; the BO_3 opalesced strongly after quarter of an hour.
12. Vesiculated KOHO in borax; made a hole with pin at top, and breathed upon it.	Deliquesced rapidly and translucently on the edges of the hole, without having clouded over or opalesced in any way; crystals afterwards formed on edges of the hole.
13. Breathed upon 1 and 4*a* when freshly re-made.	Both rapidly opalesced, but when heated very gently near spirit lamp, frothed instead of vanishing.
14. Mixed 11 with a little kryolite.	Opalesced slightly.
15. Mixed ditto with NaCl, driving off the Cl well, as I did not think it had Na enough.	Remained quite clear to date (17th).
16. Analcim.	Very difficult to make; opalesced faintly in quarter of an hour.
17. Ditto, with CaF.	Remained quite clear to date.
18. Labradorite.	Opalesced pretty strongly in twenty minutes.
19. Ditto, with CaF.	Remained quite clear to date.
20. Mixed 7 and 8.	Opalesced pretty strongly.
21. " 7 with CaF.	Remained quite clear all night.
22. " 9 " "	" " "
23. " 10 " "	" " "
24. Re-made 12 and added BO_3.	Remained clear for twenty-five minutes.
25. Re-made 1 and added $NaOCO_2$.	Opalesced faintly in quarter of an hour.
26. Re-made 21, 22, and 23, and added KOHO to each in large quantity.	Remained quite clear to date.
27. Pure boracic acid.	Opalesced round platinum wire in thirty seconds.
28. Re-made 4*a* and 1 fresh.	Opalesced in a few seconds, 4*a* quickest.
29. Re-made 20 and added $NaOCO_2$.	Remained quite clear to date.
30. Added BO_3 to 24.	Remained clear for twenty minutes.
31. Added $NaOCO_2$ to 25.	Opalesced very faintly in quarter of an hour at one end only.
32. Added more $NaOCO_2$ tto.	Remained quite clear to date.
33. Added much BO_3 to 3.	Bead very fluid; opalesced in quarter of an hour.
34. Re-made 27.	Opalesced slightly in one minute; all over in twenty minutes.

[English Edition, Vol. XX., No. 507, pages 79, 80.]

35. Added NaCl to much BO_3.	Began to opalesce in thirty seconds: completely opalesced in two and a half minutes.
36. Added more NaCl to ditto.	Remained quite clear.
37. BO_3+CaCl to saturation.	No Cl disengaged; vesicle clouded mechanically with Ca.
38. BO_3+very little CaCl.	Opalesced in one minute, but did not increase.
39. Pure boracic acid.	Opalesced slightly in half a minute; all over in five minutes.
40. Re-wetted 37 with geblase.	Bead opaque; vesicle opalesced in ten minutes.
41. BO_3 with slight trace CaF.	Opalesced in quarter of an hour.
42. The same with double CaF.	Remainder quite clear to date.
43. BO_3 with trace CaF.	Opalesced in quarter of an hour.
44. Pure boracic acid.	Opalesced slightly in half a minute; all over in three minutes.
45. $NaOCO_2$ (sub-carbonate).	Opalesced slightly in ten minutes.
46. " (double quantity).	Opalesced considerably in quarter of an hour.
47. " (more $NaCO_3$).	Remained clear to date.
48. Added KOHO to 42.	" " "

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

EXETER MEETING, AUGUST 18, 1869.

INAUGURAL ADDRESS OF THE PRESIDENT,

GEORGE GABRIEL STOKES, M.A., SEC. R.S.,
D.C.L., OXON; LL.D., DUBLIN;
FELLOW OF PEMBROKE COLLEGE; AND LUCASIAN PROFESSOR OF MATHEMATICS IN THE UNIVERSITY OF CAMBRIDGE.

MY LORDS, LADIES, AND GENTLEMEN,—

As this is the first time that the British Association for the Advancement of Science has met in the city of Exeter, and it is probable that many now present have never attended a former meeting, I hope the older members of the Association will bear with me if I say a few words in explanation of the objects for which the Association was instituted. In the first place, then, it aims at fulfilling an office which is quite distinct from that of the various scientific societies which are established in different parts of the country. These, for the most part, have for their leading object to make the voluntary labors of isolated workers in science available to the scientific world generally, by receiving, discussing, and publishing the results which they may have obtained. The British Association, on the other hand, aims at giving *a more systematic direction* to scientific inquiry, and that in various ways.

Objects of the Association.—Scientific Reports.

In a rapidly progressing branch of science it is by no means easy to become acquainted with its actual state. The workers in it are scattered throughout the civilized world, and their results are published in a variety of Transactions and scientific periodicals, mixed with other scientific matter. To make oneself, without assistance, well acquainted with what has been done, it is requisite to have access to an extensive library, to be able to read with facility several modern languages, and to have leisure to hunt through the tables of contents, or at least the indices, of a number of serial works. Without such knowledge, there is always the risk that a scientific man may spend his strength in doing over again what has been done already; whereas, with better direction, the same expenditure of time and labour might have resulted in some substantial addition to our knowledge. With a view to meet this difficulty, the British Association has requested individuals who were more specially conversant with particular departments of science, to draw up reports on the present state of our knowledge in, or on the recent progress of, special branches; and the influence of the Association as a public body has been found sufficient to induce a number of scientific men to undertake the great labour of preparing such reports.

By thus ascertaining thoroughly what we already had, what we still wanted was made more clear; and, indeed, it was one special object of the reports I have mentioned to point out what were the more prominent desiderata in the various subjects to which they related. The Association was thus the better enabled to fulfil another of its functions, that of organising means for the prosecution of researches which require co-operation. When the want is within the compass of what can be accomplished by individuals, the demand may be left to create the supply; but it often happens that a research can hardly be carried out without co-operation. It may, for instance, require a combination of the most profound theoretical knowledge with the greatest experimental skill, or an extensive knowledge of very dissimilar branches of science; or, again, the work to be done, though all of one kind, may be of such an extent as to be beyond the power of any one man. In such cases, the limited power of the individual can only be supplemented by the principle of co-operation; and, accordingly, it becomes an important part of the business of the Association to organise committees for the prosecution of special researches. The researches thus undertaken, at the request of the Association, are published at length, along with the reports on the progress of science, in the first part of the annual volume.

Money Grants.

In close connection with the last, must be mentioned another mode in which the Association contributes to the progress of science. Many researches require not only time and thought, but pecuniary outlay; and it would seem hard that scientific men who give their time and labour gratuitously to carrying out such researches should be further obliged to incur an expenditure which they often can ill afford. The Association accordingly makes grants of money to individuals or committees for defraying the expenses of such researches. It appears, from the report which has just been published, that, reckoning up to the year 1867 inclusive, the sum of £29,312 4s. 1d. has been voted by the Association for various scientific objects. Deducting from this the sum of £23 16s., for the balances of grants not wholly expended, which were returned to the Association, we may say that £29,288 8s. 1d. has been expended in the manner indicated. When we remember that these grants were mostly of small amount, and do not include personal expenses, and

that very many of the researches undertaken at the request of the Association do not involve money grants at all, we may form some idea of the amount of scientific activity which has been evoked under the auspices of the Association.

Recent Progress of Science.

In the address with which the business of the meeting is opened, it is usual for your President to give some account of the most recent progress of science. The task is by no means an easy one. Few, indeed, are familiar with science in all its branches; and even to one who was, the selection of topics, and the mode of treating them, would still present difficulties. I shall not attempt to give an account of the recent progress of science in general, but shall select, from those branches with which I am more familiar, some examples of recent progress, which may, I hope, prove to be of pretty general interest. And even in this, I feel that I shall have to crave your indulgence; for it is hard to be intelligible to some without being wearisome to others.

Astronomy.

Among the various branches of physical science, astronomy occupies, in many respects, a foremost rank. The movements of the heavenly bodies must have occupied the attention and excited the interest of mankind from the earliest ages, and accordingly the first rudiments of the science are lost in the depths of antiquity. The grandeur of the subjects of contemplation which it presents to us have won for it especial favour, and its importance in relation to navigation has caused it to be supported by national resources. Newton's great discovery of universal gravitation raised it from the rank of a science of observation to that of one admitting of the most exact mathematical deduction; and the investigation of the consequences of this law, and the explanation thereby of the lunar and planetary disturbances, have afforded a field for the exercise of the highest mathematical powers on the part of Newton and his successors. Gradually the apparent anomalies, as they might have been deemed, in the motions of the heavenly bodies, were shown to be necessary consequences of the one fundamental law; and at last, as the result of calculations of enormous labour, tables were constructed enabling the places of those bodies at any given time to be determined years beforehand with astonishing precision. A still more striking step was taken. When it had been shown, by careful calculation, that the apparent motion of the remotest of the planets then known to belong to our system could not be wholly explained on the theory of gravitation, by taking account of the disturbing powers of the other known planets, Adams, in our own country, and Le Verrier, in France, boldly reversed the problem, and, instead of determining the disturbing effect of a known planet, set themselves to inquire what must be the mass and orbit of an unknown planet which shall be capable of producing, by its disturbing force, the unexplained deviations in the position of Uranus from its calculated place. The result of this inquiry is too well known to require notice.

After these brilliant achievements, some may, perhaps, have been tempted to imagine that the field of astronomical research must have been well-nigh exhausted. Small perturbations, hitherto overlooked, might be determined, and astronomical tables thereby rendered still more exact. New asteroids might be discovered by the telescope. More accurate values of the constants with which we have to deal might be obtained. But no essential novelty of principle was to be looked for in the department of astronomy; for such we must go to younger and less mature branches of science.

Researches which have been carried on within the last few years, even the progress which has been made within the last twelve months, shows how short-sighted such an anticipation would have been; what an unexpected flood of light may sometimes be thrown over one science by its union with another; how conducive, accordingly, to the advancement of science may be an association like the present, in which not only are the workers at special sciences brought together in the sectional meetings, but in the general meetings of the Association, and in the social intercourse, which, though of an informal character, is no unimportant part of our proceedings, the cultivators of different branches of science are brought together, and have an opportunity of enlarging their minds by contact with the minds of others, who have been used to trains of thought of a very different character from their own.

The Velocity of Light.

The science of astronomy is indebted to that of optics for the principles which regulate the construction of those optical instruments which are so essential to the astronomer. It repaid its debt by furnishing to optics a result which it is important we should keep in view in considering the nature of light. It is to astronomy that we are indebted for the first proof we obtained of the finite velocity of light, and for the first numerical determination of that enormous velocity. Astronomy, again, led, forty-four years later, to a second determination of that velocity in the remarkable phenomenon of aberration discovered by Bradley, a phenomenon presenting special points of interest in relation to the nature of light, and which has given rise to some discussion, extending even to the present day, so that the Astronomer Royal has not deemed it unworthy of investigation, laborious as he foresees the trial is likely to prove, to determine the constant of aberration by means of a telescope having its tube filled with water.

If, in respect of these phenomena, optics received much aid from astronomy, the latter science has been indebted to the former for information which could not otherwise have been obtained. The motions and the masses of the heavenly bodies are revealed to us more or less fully by astronomical observations; but we could not thus become acquainted with the chemical nature of these distant objects. Yet, by the application of the spectroscope to the scrutiny of the heavenly bodies, evidence has been obtained of the existence therein of various elements known to us by the chemical examination of the materials of which our own earth is composed; and not only so, but light is thrown on the state in which matter is there existing, which, in the case of nebulæ especially, led to the formation of new ideas respecting their constitution, and the rectification of astronomical speculations previously entertained. I shall not, however, dwell further on this part of the subject, which is now of some years' standing, and has been mentioned by more than one of your former presidents, but will pass on to newer researches in the same direction.

Proper Motion of the Fixed Stars

We are accustomed to apply
fixed. Night after night

[English Edition, Vol. XX., No. 508, pages 85, 86.]

same relative arrangement; and when their places are determined by careful measurement, and certain small corrections due to known causes are applied to the immediate results of observation, they are found to have the same relative distances. But when instead of days the observations extend over months or years, it is found that the fixity is not quite absolute. Defining as fixity invariability of position as estimated with reference to the stars as a whole, and comparing the position of any individual star with those of the stars in its neighbourhood, we find that some of the stars exhibit "proper motions," show, that is, a progressive change of angular position as seen from the earth, or rather as they would be seen from the sun, which we may take for the mean annual place of the earth. This indicates linear motion in a direction transverse to the line joining the sun with the star. But since our sun is merely a star, a line drawn from the star exhibiting proper motion to our sun is, as regards the former, merely a line drawn to a star taken at random, and therefore there is no reason why the star's motion should be, except accidentally, in a direction perpendicular to the line joining the star with our sun. We must conclude that the stars, including our own sun, or some of them at least, are moving in various directions in space, and that it is merely the transversal component of the whole motion, or rather of the motion relatively to our sun, that is revealed to us by a change in the star's apparent place.

How then shall we determine whether any particular star is approaching to or receding from our sun? It is clear that astronomy alone is powerless to aid us here, since such a motion would be unaccompanied by change of angular position. Here the science of optics comes to our aid in a remarkable manner.

The pitch of a musical note depends, as we know, on the number of vibrations which reach the ear in a given time, such as a second. Suppose, now, that a body, such as a bell, which is vibrating a given number of times per second, is at the same time moving from the observer, the air being calm. Since the successive pulses of sound travel all with the velocity of sound, but diverge from different centres, namely, the successive points in the bell's path at which the bell was when those pulses were first excited, it is evident that the sound-waves will be somewhat more spread out on the side from which the bell is moving, and more crowded together on the side towards which it is moving, than if the bell had been at rest. Consequently the number of vibrations per second which reach the ear of an observer situated in the former of these directions will be somewhat smaller, and the number which reach an observer situated in the opposite direction somewhat greater, than if the bell had been at rest. Hence to the former the pitch will be somewhat lower, and to the latter somewhat higher, than the natural pitch of the bell. And the same thing will happen if the observer be in motion instead of the bell, or if both be in motion; in fact, the effect depends only on the *relative* motion of the observer and the bell in the direction of a line joining the two—in other words, on the velocity of recession or approach of the observer and the bell. The effect may be perceived in standing by a railway when a train in which the steam-whistle is sounding passes by at full speed, or better still, if the observer be seated in a train which is simultaneously moving in the opposite direction.

The present state of optical science is such as to furnish us with evidence of a force which is perfectly overwhelming, that light consists of a tremor or vibratory movement propagated in an elastic medium filling the planetary and stellar spaces, a medium which thus fulfils for light an office similar to that of air for sound. In this theory, to difference of periodic time corresponds difference of refrangibility. Suppose that we were in possession of a source of light capable, like the bell in the analogous case of sound, of exciting in the æther supposed at rest vibrations of a definite period, corresponding, therefore, to light of a definite refrangibility. Then, just as in the case of sound, if the source of light and the observer were receding from or approaching to each other with a velocity which was not insensibly small compared with the velocity of light, an appreciable lowering or elevation of refrangibility would be produced, which would be capable of detection by means of a spectroscope of high dispersive power.

Alteration of the Refrangibility of a Ray of Light.

The velocity of light is so enormous, about 185,000 miles per second, that it can readily be imagined that any motion which we can experimentally produce in a source of light is at rest in comparison. But the earth in its orbit round the sun moves at the rate of about 18 miles per second; and in the motions of stars approaching to or receding from our sun we might expect to meet with velocities comparable with this. The orbital velocity of the earth is, it is true, only about the one ten-thousandth part of the velocity of light. Still the effect of such a velocity on the refrangibility of light, which admits of being easily calculated, proves not to be so insensibly small as to elude all chance of detection, provided only the observations are conducted with extreme delicacy.

But how shall we find in such distant objects as the stars an analogue of the bell which we have assumed in the illustration drawn from sound? What evidence can we ever obtain, even if an examination of their light should present us with rays of definite refrangibility, of the existence in those remote bodies of ponderable matter vibrating in known periods not identical with those corresponding to the refrangibilities of the definite rays which we observe? The answer to this question will involve a reference, which I will endeavor to make as brief as I can, to the splendid researches of Professor Kirchhoff. The exact coincidence of certain dark lines in the solar spectrum with bright lines in certain artificial sources of light had previously been in one or two instances observed; but it is to Kirchhoff we owe the inference from an extension of Prevost's theory of exchanges, that a glowing medium which emits bright light of any particular refrangibility *necessarily* (at that temperature at least) acts as an absorbing medium, extinguishing light of the same refrangibility. In saying this it is but just to mention that, in relation to radiant heat (from whence the transition to light is easy), Kirchhoff was preceded, though unconsciously, by our own countryman, Mr. Balfour Stewart. The inference which Kirchhoff drew from Prevost's theory thus extended led him to make a careful comparison of the places of the dark lines of the solar spectrum with those of bright lines produced by the incandescent gas or vapour of known elements; and the coincidences were in many cases so remarkable as to establish almost to a certainty the existence of several of the known elements in the solar atmosphere, producing by their absorbing action the dark lines coinciding with the bright lines observed. Among

other elements may be mentioned in particular hydrogen, the spectrum of which, when traversed by an electric discharge, shows a bright line or band exactly coinciding with the dark line C, and another with the line F.

Mr. Huggins's Researches on Sirius—Determination of Radial Proper Motion.

Now Mr. Huggins found that several of the stars show in their spectra dark lines coinciding in position with C and F; and what strengthens the belief that this coincidence, or apparent coincidence, is not merely fortuitous, but is due to a common cause, is that the two lines are found associated together, both present or both absent; and Kirchhoff's theory suggests that the common cause is the existence of hydrogen in the atmospheres of the sun and certain stars, and its exercise of an absorbing action on the light emitted from beneath.

Now, by careful and repeated observations with a telescope furnished with a spectroscope of high dispersive power, Mr. Huggins found that the F line, the one selected for observation, in the spectrum of Sirius did not exactly coincide with the corresponding bright line of a hydrogen spark, which latter agrees in position with the solar F, but was a *little* less refrangible, while preserving the same general appearance. What conclusion, then, are we to draw from the result? Surely it would be most unreasonable to attribute the dark lines in the spectra of the sun and of Sirius to distinct causes, and to regard their almost exact coincidence as purely fortuitous, when we have in proper motion a *vera causa* to account for a minute difference. And if, as Kirchhoff's labours render almost certain, the dark solar line depends on the existence of hydrogen in the atmosphere of our sun, we are led to infer that that element, with which the chemist working in his laboratory is so familiar, exists and is subject to the same physical laws in that distant star, so distant, that, judging by the most probable value of its annual parallax, light which would go seven times round our earth in one second would take fourteen years to travel from the star. What a grand conception of the unity of plan pervading the universe do such conclusions present to our minds!

Assuming, then, that the small difference of refrangibility observed between the solar F and that of Sirius is due to proper motion, Mr. Huggins concludes from his measures of the minute difference of position that at the time of the observation, Sirius was receding from the earth at the rate of 41·4 miles per second. A part of this was due to the motion of the earth in its orbit; and on deducting the orbital velocity of the earth, resolved in the direction of a line drawn from the star, there remained 29·4 miles per second as the velocity with which Sirius and our sun are mutually receding from each other. Considering the minuteness of the quantity on which the result depends, it is satisfactory to find that Mr. Huggins's results as to the motion of Sirius have been confirmed by the observations of Father Secchi made at Rome with a different instrument.

The determination of radial proper motion in this way is still in its infancy. It is worthy of note that, unlike the detection of transversal proper motion by change of angular position, it is equally applicable to stars at all distances, provided they are bright enough to render the observations possible. It is co[n]
that the results of these observatio[ns]
lead to a determination of the motion of the solar system in space, which is more trustworthy than that which has been deduced from changes of position, as being founded on a broader induction, and not confined to conclusions derived from the star in our neighbourhood. Should even the solar system and the nearer stars be drifting along, as Sir John Herschel suggests, with an approximately common motion, like motes in a sunbeam, it is conceivable that the circumstance might thus be capable of detection. To what wide speculations are we led as to the possible progress of our knowledge when we put together what has been accomplished in different branches of science!

Spectrum Observations of the Solar Eclipse.

I turn now to another recent application of spectral analysis. The phenomenon of a total solar eclipse is described by those who have seen it as one of the most imposing that can be witnessed. The rarity of its occurrence and the shortness of its duration afford, however, opportunity for only a hasty study of the phenomena which may then present themselves. Among these, one of the most remarkable, seen indeed before, but first brought prominently into notice by the observers who watched the eclipse of July 7, 1842, consists in a series of mountain-like or cloud-like luminous objects seen outside the dark disk of the moon. These have been seen in subsequent total eclipses, and more specially studied, by means of photography, by Mr. Warren De La Rue in the eclipse of June 18, 1860. The result of the various observations, and especially the study, which could be made at leisure, of the photographs obtained by Mr. De La Rue, proved conclusively that these appendages belong to the sun, not to the moon. The photographs proved further their light to be remarkable for actinic power. Since that time the method of spectral analysis has been elaborated; and it seemed likely that additional information bearing on the nature of these objects might be obtained by the application of the spectroscope. Accordingly various expeditions were equipped for the purpose of observing the total solar eclipse which was to happen on August 17, 1868. In our own country an equatorially mounted telescope, provided with a spectroscope, was procured for the purpose by the Royal Society, which was entrusted to Lieut. (now Captain) Herschel, who was going out to India, one of the countries crossed by the line of the central shadow. Another expedition was organized by the Royal Astronomical Society, under the auspices of Major Tennant, who was foremost in pressing on the attention of scientific men the importance of availing themselves of the opportunity.

Shortly before the conclusion of the meeting of the Association at Norwich last year, the first results of the observations were made known to the meeting through the agency of the electric telegraph. In a telegram sent by M. Janssen to the President of the Royal Society, it was announced that the spectrum of the prominences was very remarkable, showing bright lines, while that of the corona showed none. Brief as the message necessarily was, one point was settled. The prominences could not be clouds in the strict sense or the term, shining either by virtue of their own heat, or by light reflected from below. They must consist of incandescent matter in the *gaseous* form. It appeared, from the more detailed accounts received by post from the various observers, and put together at leisure, that, the immediate neighbourhood of the sun, the [co]nsisted mainly of three

bright lines, of which two coincided with C and F, and the intermediate one nearly, but, as subsequent researches showed, not exactly with D. The bright lines coinciding with C and F indicate the presence of glowing hydrogen. Several of the other lines were identified with those which would be produced by the incandescent vapour of certain other elements.

This is precious information to have gathered during the brief interval of the total phase, and required, on the part of the observers, self-denial in withdrawing the eye from the imposing spectacle of the surrounding scenery, and coolness in proceeding steadily with some definite part of the inquiry, when so many questions crowded for solution, and the fruits of months of preparation were to be reaped in three or four minutes or lost altogether, especially when, as too often happened, the observations were provokingly interrupted by flying clouds.

But, valuable as these observations were, it is obvious that we should have had long to wait before we could have become acquainted with the usual behaviour of these objects, and their possible relation to changes which may be going on at the surface of the sun, if we had been dependent on the rare and brief phenomenon of a total solar eclipse for gathering information respecting them. But how, the question might be asked, shall we ever be able so to subdue the overpowering glare of our great luminary, and the dazzling illumination which it produces in our atmosphere when we look nearly in its direction, as to perceive objects which are comparatively so faint? Here, again, the science of optics comes in aid of astronomy.

Spectral Examination of the Eclipse Prominences.

When a line of light—such as a narrow slit held in front of a luminous object—is viewed through a prism, the light is ordinarily spread out into a coloured band, the length of which may be increased at pleasure by substituting two or more prisms for the single prism. As the total quantity of light is not thereby increased, it is obvious that the intensity of the light of the coloured band will go on decreasing as the length increases. Such is the case with ordinary sources of light—like the flame of a candle, or the sky, which give a continuous spectrum, or one generally continuous, though interrupted by dark bands. But, if the light from the source be homogeneous, consisting, that is, of light of one degree of refrangibility only, the image of the slit will be merely deviated by the prisms, not widened out into a band, and not consequently reduced in intensity by the dispersion. And, if the source of light emit light of both kinds, it will be easily understood that the images of the slit corresponding to light of any definite refrangibilities which the mixture may contain will stand out, by their superior intensity, on the weaker ground of the continuous spectrum.

Preparations for observations of the kind had long been in progress in the hands of our countryman, Mr. Lockyer. His first attempts were unsuccessful; but, undismayed by failure, he ordered the construction of a new spectroscope of superior power, in which he was aided by a grant from the sum placed annually by Parliament at the disposal of the Royal Society for scientific purposes. The execution of this instrument was delayed by what proved to be the last illness of the eminent optician to whom it was entrusted (the late Mr. Cooke); but, when at last the instrument was placed in his hands, Mr. Lockyer was not long in *discovering* the object of his two years' search. On the 20th of October last year, in examining the space immediately surrounding the edge of the solar disk, he obtained evidence, by the occurrence of a bright line in the spectrum, that his slit was on the image of one of those prominences the nature of which had so long been an enigma. It further appeared, from an observation made on November 5th (as indeed might be expected from the photographs of Mr. De La Rue, and the descriptions of those who had observed total solar eclipses), that the prominences were merely elevated portions of an extensive luminous stratum of the same general character, which, now that the necessity of the interposition of the moon was dispensed with, could be traced completely round the sun. Notices of this discovery were received from the author by the Royal Society on October 21st and November 3d, and the former was almost immediately published in No. 105 of the "Proceedings." These were shortly afterwards followed by a fuller paper on the same subject.

Meanwhile, the same thing had been independently observed in another part of the world. After having observed the remarkable spectrum of the prominences during the total eclipse, it occurred to M. Janssen that the same method might allow the prominences to be detected at any time; and, on trial, he succeeded in detecting them the very day after the eclipse. The results of his observations were sent by post, and were received shortly after the account of Mr. Lockyer's discovery had been communicated by Mr. De La Rue to the French Academy.

In the way hitherto described, a prominence is not seen as a whole, but the observer knows when its image is intercepted by the slit; and, by varying a little the position of the slit, a series of sections of the prominence are obtained, by putting which together the form of the prominence is deduced. Shortly after Mr. Lockyer's communication of his discovery, Mr. Huggins, who had been independently engaged in the attempt to render the prominences visible by the aid of the spectroscope, succeeded in seeing a prominence as a whole by somewhat widening the slit, and using a red glass to diminish the glare of the light admitted by the slit, the prominence being seen by means of the C line in the red. Mr. Lockyer had a design for seeing the prominences as a whole by giving the slit a rapid motion of small extent; but this proved to be superfluous, and they are now habitually seen with their actual forms. Nor is our power of observing them restricted to those which are so situated that they are seen by projection outside the sun's limb; such is the power of the spectroscopic method of observation that it has enabled Mr. Lockyer and others to observe them right on the disk of the sun—an important step for connecting them with other solar phenomena.

One of the most striking results of the habitual study of these prominences is the evidence they afford of the stupendous changes which are going on in the central body of our system. Prominences, the heights of which are to be measured by thousands and tens of thousands of miles, appear and disappear in the course of some minutes. And a study of certain minute changes of position in the bright line F, which receive a simple and natural explanation by referring them to proper motion in the glowing gas by which that line is produced, and which we see no other way of accounting for, have led Mr. Lockyer to conclude that the gas in question is sometimes travelling with velocities comparable with that of the earth in its orbit. Moreover, these exhibitions of intense action are frequently

to be intimately connected with the spots, and can hardly fail to throw light on the disputed question of their formation. Nor are chemical composition and proper motion the only physical conditions of the gas which are accessible to spectral analysis. By comparing the breadth of the bright bands (for, though narrow, they are not mere lines) seen in the prominences with those observed in the spectrum of hydrogen rendered incandescent under different physical conditions, Dr. Frankland and Mr. Lockyer have deduced conclusions respecting the pressure to which the gas is subject in the neighbourhood of the sun. I am happy to say that Mr. Lockyer has consented to deliver a discourse during our meeting, in which the whole subject will doubtless be fully explained.

The Great Southern Telescope.

I have dwelt, perhaps, too long on this topic, and I cannot help fearing that I may have been tedious to the many scientific men to whom the subject is already perfectly familiar; yet the contemplations which it opens out to us are so exalted, and the proof which it affords of what can be accomplished by the union of different branches of science is so striking, that I hope I may be pardoned for occupying your time. I cannot, however, leave the subject of astronomy without congratulating the Association on the accomplishment of an object which originated with it, and in the promotion of which it formerly took an active part. It was at the meeting of the Association at Birmingham in 1849, under the presidency of the Rev. Dr. Robinson, that a resolution was passed for making an application to Her Majesty's Government to establish a reflector of not less than 3 feet aperture at the Cape of Good Hope, and to make such additions to the staff of that observatory as might be necessary for its effectual working. This resolution met with the hearty concurrence of the President of the Council of the Royal Society, who suggested that the precise locality in the Southern Hemisphere where the telescope should be erected had best be left an open question. This modification having been adopted by your Council, the application was presented to Earl Russell, then First Lord of the Treasury, by representatives of both bodies early in 1850. A reply was received from Government to the effect that, though they agreed with the Association as to the interest which attached itself to the inquiry, yet there was so much difficulty attending the arrangements that they were not prepared to take any steps without much further inquiry. This reply was considered so far favourable as not to forbid the hope of success if the application were renewed on a suitable opportunity. The subject was again brought before the Association, by Colonel (now General Sir Edward) Sabine, in his opening address as President at the Belfast meeting in 1852. The result was that the matter was again brought before Government by a committee of the British Association, acting in conjunction with a committee of the Royal Society, by means of an application made to the Earl of Aberdeen. By this time the country was engaged in the Russian war, in consequence of which, it was replied, no funds could then be spared; but a promise was given that, when the crisis then impending was past, the matter should be taken up—a promise which the retirement from office and subsequent death of Lord Aberdeen rendered of no avail.

But, though failing in its immediate object, the action of the British Association in the matter has not remained fruitless. The subject was warmly taken up at Melbourne, and, after preliminary correspondence between the Board of Visitors of the Melbourne Observatory and the President and Council of the Royal Society, and the appointment by the latter body of a committee to consider and report on the subject, in April, 1864, a proposition was made to the Colonial Legislature for a grant of £5000 for the construction of a telescope, and was acceded to. Not to weary you with details, I will merely say that the telescope has been constructed by Mr. Grubb, of Dublin, and is now erected at Melbourne, and in the hands of Mr. Le Sueur, who has been appointed to use it. It is a reflector of 4 feet aperture, of the Cassegrain construction, equatorially mounted, and provided with a clock-movement. Before its shipment, it was inspected in Dublin by the committee appointed by the Royal Society to consider the best mode of carrying out the object for which the vote was made by the Melbourne Legislature; and the committee speak in the highest terms of its contrivance and execution. We may expect before long to get a first instalment of the results obtained by a scrutiny of the southern heavens with an instrument far more powerful than any that has hitherto been applied to them—results which will, at the same time, add to our existing knowledge, and redound to the honor of the colony by whose liberality this long-cherished object has at last been effected.

Researches on Gun-Cotton.

As I have mentioned an application to the Government on the part of the Association which was not successful, it is but right to say that such is not generally the result: I will refer to one instance. At the Cambridge meeting of the Association, in 1862, a committee, consisting of representatives of the Mechanical and Chemical Sections, was appointed for the purpose of investigating the application of gun-cotton to warlike purposes. At the Newcastle meeting, in the following year, this committee presented their report. It was felt that a complete study of the subject demanded appliances which could be obtained only from our military resources; and at the Newcastle meeting a resolution was passed recommending the appointment of a royal commission. This recommendation was adopted, and, in 1864, a commission was appointed, which was requested to report on the application of gun-cotton to civil as well as to naval and military purposes. The committee gave in their report last year, and that report, together with a more recent return relative to the application of gun-cotton to mining and quarrying operations, has just been printed for the House of Commons.

A substance of such comparatively recent introduction cannot be fairly compared with an explosive in the use of which we have the experience of centuries. Yet, even with our present experience, there are some purposes for which gun-cotton can advantageously replace gunpowder, while its manufacture and storage can be effected with comparative safety, since it is in a wet state during the process of manufacture, and is not at all injured by being kept permanently in water, but merely requires to be dried for use. Even should it be required to store it in the dry state, it is doubtful whether, with the precautions indicated by the chemical investigations of Mr. Abel, any greater risk is incurred than in the case of gunpowder. In the blasting of hard rocks it is found to be highly efficient; while the remarkable results recently obtained by Mr. Abel leave no doubt of its value for explosions such as are

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frequently required in warfare. General Hay speaks highly of the promise of its value for small arms; but many more experiments are required, especially as a change in the arm and mode of ignition require a change in the construction of the cartridge. In heavy ordnance, the due control of the rapidity of combustion of the substance is a matter of greater difficulty; and, though considerable progress has been made, much remains to be done before the three conditions of safety to the gun, high velocity of projection, and uniformity of result, are satisfactorily combined.

Deep Sea Soundings.

By the kindness of Dr. Carpenter, I am enabled to mention to you the latest results obtained in an expedition which could not have been undertaken without the aid of Government—an aid which was freely given. Last year, Dr. Carpenter and Professor Wyville Thomson represented to the President and Council of the Royal Society the great importance to zoology and palæontology of obtaining sounding from great depths in the ocean, and suggested to them to use their influence with the Admiralty to induce them to place a gun-boat, or other suitable vessel, at the disposal of those gentlemen, and any other naturalists who might be willing to accompany them, for the purpose of carrying on a systematic course of deep-sea dredging for a month or six weeks. This application was forwarded to the Admiralty with the warm support of the President and Council, and was readily acceded to. The operations were a good deal impeded by rough weather, but, nevertheless, important results were obtained. Dredging was successfully accomplished at a depth of 650 fathoms; and the existence was established of a varied and abundant submarine fauna, at depths which had generally been supposed to be either azoic or occupied by animals of a very low type; and the character of the fauna and of the mud brought up was such as to point to a chalk formation actually going on.

It seemed desirable to carry the soundings to still greater depths, and to examine more fully the changes of temperature which had been met with in the descent. Another application was accordingly made to the Admiralty, in the present year, and was no less readily acceded to than the former; and a larger vessel than that used last year is now on her cruise. I am informed by Dr. Carpenter that dredging has been successfully carried down to more than 2400 fathoms (nearly the height of Mont Blanc), and that animal life has been found, even at that depth, in considerable *variety*, though its *amount* and *kind* are obviously influenced by the reduction of temperature to Arctic coldness. A very careful series of temperature soundings has been taken, showing, on the same spot, a continuous descent of temperature with the depth, at first more rapid, afterward pretty uniform. Thermometers protected from pressure by a plan described by Dr. Miller were found to maintain their character at the great depths reached, the difference between them and the best ordinary thermometers used in the same sounding being exactly conformable to the pressure corresponding with each depth, as determined by the experiments previously made in smaller depths. All the observations hitherto made go to confirm the idea of a general interchange of polar and equatorial water, the former occupying the lowest depths, the latter forming a superficial stratum of 700 or 800 fathoms. *The analyses* of the water brought up indicate a large proportion of carbonic acid in the gases of the deep waters, and a general diffusion of organic matter.

The Faraday Memorial.

I must turn, for a few moments, to another application recently made to Government, which has not been successful. The application I have in view was made, not by the British Association or other scientific societies in their corporate capacity, but by a body composed of the Presidents of the British Association, and of the Royal and other leading scientific societies; and its object was, not the promotion of science directly, but the recognition of pre-eminent scientific merit. In the history of science, few names, indeed, hold so prominent a place as that of Faraday. The perfect novelty of principle, and recondite nature of many of his great discoveries, are such as to bear the impress of genius of the highest order, and to form an epoch in the advance of science; and, while his scientific labours excited the admiration of men of science throughout the world, his singularly genial disposition, and modest, unassuming character, won for him the love of those who had the happiness of numbering him among their personal friends. At a meeting of the presidents of the scientific societies to which I have alluded, it was resolved to erect a marble statue in memory of Faraday. He was a man of whom England may well be proud, and it was thought that it would be a graceful recognition of his merits if the monument were erected at the public expense. The present Chancellor of the Exchequer, however, did not think it right that the recognition of scientific merit, however eminent, should fall on the taxation of the country, though, even in a pecuniary point of view, the country has received so much benefit from the labours of scientific men. The carrying out of the resolution being thus left to private exertion, a public meeting, presided over by H. R. H. the Prince of Wales, was held in the Royal Institution, an establishment which has the honour of being identified with Faraday's scientific career. At this meeting a committee was formed to carry out the object, and a subscription list commenced. By permission of the secretaries of this association, an office has been opened in the Reception Room, where those members of the association who may be desirous of taking part in the movement will have every facility afforded them.

Recent Discoveries in Chemistry.

In chemistry, I do not believe that any great step has been made within the last year; but perhaps there is no science in which an earnest worker is so sure of being rewarded by making some substantial acquisition to our knowledge, though it may not be of the nature of one of those grand discoveries which from time to time stamp their impress on different branches of science. I may be permitted to refer to one or two discoveries which are exceedingly curious, and some of which may prove of considerable practical importance

Turacine.

The turaco or plantain-eater of the Cape of Good Hope is celebrated for its beautiful plumage. A portion of the wings is of a fine red colour. This red colouring-matter has been investigated by Professor Church, who finds it to contain nearly six per cent. of copper, which cannot be distinguished by the ordinary tests, nor removed from the colouring-matter without destroying it. The colouring-matter is, in fact, a natural organic compound, of which copper is one of the essential constitu-

ents. Traces of this metal had previously been found in animals—for example, in oysters, to the cost of those who partook of them. But, in these cases, the presence of the copper was merely accidental; thus oysters that lived near the mouths of streams which came down from copper mines assimilated a portion of the copper salt, without apparently its doing them either good or harm. But, in the turaco, the existence of the red colouring-matter which belongs to their normal plumage is dependent upon copper, which, obtained in minute quantities with the food, is stored up in this strange manner in the system of the animal. Thus, in the very same feather, partly red and partly black, copper was found in abundance in the red parts, but none, or only the merest trace, in the black.

This example warns us against taking too utilitarian a view of the plan of creation. Here we have a chemical substance elaborated which is perfectly unique in its nature, and contains a metal the salts of which are ordinarily regarded as poisonous to animals; and the sole purpose to which, so far as we know, it is subservient in the animal economy is one of pure decoration. Thus, a pair of fine birds which were kept in captivity lost their fine red colour in the course of a few days, in consequence of washing in the water which was left them to drink, the red colouring-matter, which is soluble in water, being thus washed out; but, except as to the loss of their beauty, it does not appear that the birds were the worse for it.

Artificial Alizarine.

A large part of the calicos which are produced in this country in such enormous quantities are sent out into the market in the printed form. Although other substances are employed, the place which madder occupies among dye-stuffs with the calico-printer is compared by Mr. Schunck to that which iron occupies among metals with the engineer. It appears, from the public returns, that upwards of 10,000 tons of madder are imported annually into the United Kingdom. The colours which madder yields to mordanted cloth are due to two substances, alizarine and purpurine, derived from the root. Of these, alizarine is deemed the most important, as producing faster colours and yielding finer violets. In studying the transformations of alizarine under the action of chemical reagents, MM. Græbe and Liebermann were led to connect it with anthracene, one of the coal-tar series of bodies, and to devise a mode of forming it artificially. The discovery is still too recent to allow us to judge of the cost with which it can be obtained by artificial formation, which must decide the question of its commercial employment. But, assuming it to be thus obtained at a sufficiently cheap rate, what a remarkable example does the discovery afford of the way in which the philosopher, quietly working in his laboratory, may obtain results which revolutionise the industry of nations! To the calico-printer, indeed, it may make no very important difference, whether he continues to use madder, or replaces it by the artificial substance; but what a sweeping change is made in the madder-growing interest! What hundreds of acres, hitherto employed in madder cultivation, are set free for the production of human food, or of some other substance useful to man! Such changes can hardly be made without temporary inconvenience to those who are interested in the branches of industry effected; but we must not, on that account, attempt to stay the progress of discovery, which is conducive to the general weal.

Apomorphia.

Another example of the way in which practical applications unexpectedly turn up when science is pursued for its own sake, is afforded by the result recently obtained by Dr. Matthiessen, in his investigation of the constitution of the opium bases. He found that, by the action of hydrochloric acid on morphia, a new base was produced, which, as to composition, differed from the former merely by the removal of one equivalent of water. But the physiological action of the new base was utterly different from that of the original one. While morphia is a powerful narcotic, the use of which is apt to be followed by subsequent depression, the new base was found to be free from narcotic properties, but to be a powerful emetic, the action of which was unattended by injurious after-effects. It seems likely to become a valuable remedial agent.

In relation to mechanism, this year is remarkable as being the centenary of the great invention of our countryman, James Watt. It was in the year 1769 that he took out his patent involving the invention of separate condensation, which is justly regarded as forming the birth of the steam-engine. Little could even his inventive mind have foreseen the magnitude of the gift he was conferring on mankind in general, and on his own country more particularly. In these days of steamers, power-looms, and railways, it requires no small effort to place ourselves, in imagination, in the condition we should be in without the steam-engine. It needs no formal celebration to remind Britons of what they owe to Watt. Of him, truly it may be said "*si monumentum requiras, circumspice.*"

The Relations between Physical and Biological Sciences.

With reference to those branches of science in which we are more or less concerned with the phenomena of life, my own studies give me no right to address you. I regret this the less because my predecessor, and my probable successor in the presidential chair are both of well-known eminence in this department. But I hope I may be permitted, as a physicist, and viewing the question from the physical side, to express to you my views as to the relation which the physical bear to the biological sciences.

No other physical science has been brought to such perfection as mechanics; and in mechanics we have long been familiar with the idea of the perfect generality of its laws, of their applicability to bodies organic as well as inorganic, living as well as dead. Thus, in a railway collision, when a train is suddenly arrested, the passengers are thrown forward, by virtue of the inertia of their bodies, precisely according to the laws which regulate the motion of dead matter. So trite has the idea become, that the reference to it may seem childish; but, from mechanics, let us pass on to chemistry, and the case will be found by no means so clear. When chemists ceased to be content with the mere ultimate analysis of organic substances, and set themselves to study their proximate constituents, a great number of definite chemical compounds were obtained which could not be formed artificially. I do not know what may have been the usual opinion at that time among chemists as to their mode of formation. Probably it may have been imagined that chemical affinities were indeed concerned in their formation, but controlled and modified by an assumed vital force. But, as the science progressed, many of these organic substances were formed artificially, in some cases from other and perfectly distinct organic substances, in other cases actu-

ally from their elements. This statement must, indeed, be accepted with one qualification. It was stated several years ago, by M. Pasteur, and I believe the statement still remains true, that no substance, the solution of which possesses the property of rotating the plane of polarisation of polarised light, had been formed artificially from substances not possessing that property. Now several of the natural substances which are deemed to have been produced artificially are active, in the sense of rotating the plane of polarisation; and, therefore, in these cases, the inactive artificial substances cannot be absolutely identical with the natural ones. But the inactivity of the artificial substance is readily explained on the supposition that the artificial substance bears to the natural the same relation as racemic acid bears to tartaric—that it is, so to speak, a mixture of the natural substance with its image in a mirror. And when we remember by what a peculiar and troublesome process M. Pasteur succeeded in separating racemic acid into the right-handed and left-handed tartaric acids, it will be at once understood how easily the fact, if it be a fact, of the existence, in the natural substance, of a mixture of two substances, one right-handed and the other left-handed, but otherwise identical, may have escaped detection. This is a curious point, to the clearing up of which it is desirable that chemists should direct their attention. Waiving, then, the difference of activity or inactivity, which, as we have seen, admits of a simple physical explanation, though the correctness of that explanation remains to be investigated, we may say that, at the present time, a considerable number of what used to be regarded as essentially natural organic substances have been formed in the laboratory. That being the case, it seems most reasonable to suppose that, in the plant or animal from which those organic substances were obtained, they were formed by the play of ordinary chemical affinity, not necessarily nor probably by the same series of reactions by which they were formed in the laboratory, where a high temperature is commonly employed, but still by chemical reactions of some kind, under the agency, in many cases, of light, an agency sometimes employed by the chemist in his laboratory. And, since the boundary line between the natural substances which have and those which have not been formed artificially, is one which, so far as we know, simply depends upon the amount of our knowledge, and is continually changing as new processes are discovered, we are led to extend the same reasoning to the various chemical substances of which organic structures are made up.

But do the laws of chemical affinity, to which, as I have endeavoured to infer, living beings, whether vegetable or animal, are in absolute subjection, together with those of capillary attraction, of diffusion, and so forth, account for the formation of an organic structure, as distinguished from the elaboration of the chemical substances of which it is composed? No more, it seems to me, than the laws of motion account for the union of oxygen and hydrogen to form water, though the ponderable matter so uniting is subject to the laws of motion during the act of union just as well as before and after. In the various processes of crystallisation, of precipitation, and so forth, which we witness in dead matter, I cannot see the faintest shadow of an approach to the formation of an organic structure, still less to the wonderful series of changes which are concerned in the growth and perpetuation of even the lowliest plant. Admitting, to the full, as highly probable, though not completely demonstrated, the applicability to living beings of the laws which have been ascertained with reference to dead matter, I feel constrained, at the same time, to admit the existence of a mysterious *something* lying beyond—a something, *sui generis*, which I regard, not as balancing and suspending the ordinary physical laws, but as working with them and through them to the attainment of a designed end.

What this *something*, which we call life, may be, is a profound mystery. We know not how many links in the chain of secondary causation may yet remain behind; we know not how few. It would be presumptuous, indeed, to assume, in any case, that we had already reached the last link, and to charge with irreverence a fellow worker who attempted to push his investigations yet one step further back. On the other hand, if a thick darkness enshrouds all beyond, we have no right to assume it to be impossible that we should have reached even the last link of the chain; a stage where further progress is unattainable, and we can only refer the highest law at which we stopped to the fiat of an Almighty Power. To assume the contrary as a matter of necessity, is, practically, to remove the First Cause of all to an infinite distance from us. The boundary, however, between what is clearly known and what is veiled in impenetrable darkness, is not ordinarily thus sharply defined. Between the two there lies a misty region, in which loom the ill-discerned forms of links of the chain which are yet beyond us. But the general principle is not effected thereby. Let us fearlessly trace the dependence of link on link as far as it may be given us to trace it; but let us take heed that, in thus studying second causes, we forget not the First Cause, nor shut our eyes to the wonderful proofs of design which, in the study of organised beings especially, meet us at every turn.

Truth we know must be self-consistent, nor can one truth contradict another, even though the two may have been arrived at by totally different processes—in the one case, suppose, obtained by sound scientific investigation, in the other case taken on trust from duly authenticated witnesses. Misinterpretations, of course, there may be on the one side or on the other, causing apparent contradictions. Every mathematician knows that in his private work he will occasionally, by two different trains of reasoning, arrive at discordant conclusions. He is at once aware that there must be a slip somewhere, and sets himself to detect and correct it. When conclusions rest on probable evidence, the reconciling of apparent contradictions is not so simple and certain. It requires the exercise of a calm, unbiassed judgment, capable of looking at both sides of the question; and oftentimes we have long to suspend our decision, and seek for further evidence. None need fear the effect of scientific inquiry carried on in an honest, truth-loving, humble spirit, which makes us no less ready frankly to avow our ignorance of what we cannot explain, than to accept conclusions based on sound evidence. The slow but sure path of induction is open to us. Let us frame hypotheses if we will: most useful are they when kept in their proper place, as stimulating inquiry. Let us seek to confront them with observation and experiment, thereby confirming or upsetting them, as the result may prove; but let us beware of placing them prematurely in the rank of ascertained truths, and building further conclusions on them, as if they were.

When, from the phenomena of life, we pass on to those of mind, we enter a region still more profoundly mysterious. We can readily imagine that we may here be dealing with phenomena altogether transcending

those of mere life, in some such way as those of life transcend, as I have endeavoured to infer, those of chemistry and molecular attractions, or as the laws of chemical affinity, in their turn, transcend those of mere mechanics. Science can be expected to do but little to aid us here, since the instrument of research is itself the object of investigation. It can but enlighten us as to the depth of our ignorance, and lead us to look to a higher aid for that which most nearly concerns our well-being.

Section B.

ADDRESS

TO THE

CHEMICAL SECTION.

AUGUST 19, 1869.

BY DR. DEBUS, F.R.S., PRESIDENT.

I BELIEVE it has been the custom with many of my predecessors in this office to place before the members of the British Association a Report of the progress of Chemistry during the year preceding their election. In attempting to follow their example, I soon found that it would be impossible for me, without making too great a demand upon your time, to give even a bare outline of the more important chemical work done during the year. A science, the report of whose yearly advances fills about 1000 large octavo pages, cannot, by any powers of mine, have its progress chronicled in an address of half an hour's duration. The best course open to me under such circumstances is to direct your attention to the ideas which at present guide chemists in their researches, to place in a clear light the objects they are striving to attain, and to indicate the direction of scientific thought of our time. To do this is by no means an easy task; for the more manifold and diversified the objects of a science become—the more numerous and extensive its relations with other branches of knowledge, the more difficult it becomes to draw a picture of its actual condition.

It is always an excellent recommendation to a theory or hypothesis when, amongst the cultivators of the science to which it pertains, very little difference of opinion exists as regards its admissibilty and scientific value. This is, in a high degree, the case with regard to the atomic theory. The vast majority of chemists, I believe, accept this theory as the most suitable exponent of the fundamental truths of their science; and certainly, if the quality of the tree may be judged by its fruit, there is no other view which furnishes a clearer image to our minds of the chemical constitution of bodies, and, at the same time, conducts to the discovery of so many important facts and relations. By Dalton's profound hypothesis, all bodies are supposed to be composed of atoms of infinitely small dimensions. But these atoms are supposed not to be single; two or more of them are held together by certain forces, and thus constitute what is called a molecule. One atom of carbon, one atom of calcium, and three atoms of oxygen, joined together by the force called chemical affinity, constitute a molecule of carbonate of lime. Vast numbers of such molecules, bound to each other by the force of cohesion, form a visible piece of chalk. If a chemist wishes to examine a body, his first endeavour is to ascertain of what sort of atoms the body is formed. This is a mere matter of experiment. He next determines how many of such atoms are contained in each molecule of the body, and, finally, he ascertains how these atoms are arranged, or, more correctly, combined within the molecule; for it is quite clear that a substance like saltpetre, which contains one atom of nitrogen, one of potassium, and three of oxygen, may have these atoms arranged in very different manners, and still have the same composition. We might assume the potassium and nitrogen in more intimate union, nearer to each other than they are to oxygen, or we might consider nitrogen and oxygen more closely packed together, and, so to speak, attached as a whole to the potassium; in both cases, saltpetre would have in each molecule the same number of atoms, and the weight of the molecule would be the same. The three determinations just mentioned are of fundamental importance to the chemist; not that such inquiries are the only ones which interest him, for we shall, in the sequel, notice others of almost equal importance.

Nor must it be supposed that questions of this nature are of quite a modern date; for Leucippus, 500 B.C., appears to have sought to explain the nature of things, by the assumption that they are formed by the union of small particles, which latter received the name of atoms from Epicurus. It is true the notion of atoms, as conceived by the Grecian philosophers, is not quite the same as ours, but their speculations contain our notions pretty much in the same way as the acorn contains the oak-tree.

The determination of the quality of the atoms in a molecule, or the analysis of the latter, has not undergone many changes during the last few years; and the same may be said about finding of the relative weight of a molecule, or the determination of the number of atoms which are contained in it. With regard to the latter point, however, it may be mentioned that Avogadro's hypothesis, according to which equal volumes of gaseous substances, measured at the same temperature and pressure, contain the same number of molecules, guides us chiefly in assigning to each molecule its relative weight and its number of atoms; this hypothesis has won more and more the confidence of chemists, and it is now admitted to hold good in nearly all well-examined cases.

Our views relative to the combinations of atoms in molecules, and our methods of ascertaining this arrangement, have, however, undergone great alterations, and received great additions, during the last ten or fifteen years. To a consideration of these changes I will now, for a short time, invite your attention. Since our modern views, however, originated, in a great measure, from the study of organic bodies, and since the majority of chemists now devote their time and labour thereto, I shall confine my remarks principally to the organic branch of the subject.

Eighteen years ago, Prof. Williamson read before the members of this Association a remarkable paper, which contained the germ of our modern chemical views, and was the cause of many discoveries. He proposed to regard three large classes of bodies, acids, bases, and salts from the same point of view, and to compare their chemical properties with those of one single elected substance. For this term of comparison he chose water. Now water is composed of three atoms—two of hydrogen and one of oxygen. Williamson showed that all oxygen acids—all oxygen bases, and the salts resulting from a combination of the two—can, like water, be considered to be composed of three parts, or radicals, tv

hydrogen atoms in water, and the third that of the atom of oxygen, thus:—

$\left.\begin{matrix}H\\H\end{matrix}\right\}O$	$\left.\begin{matrix}K\\H\end{matrix}\right\}O$	$\left.\begin{matrix}NO\\H\end{matrix}\right\}O$	$\left.\begin{matrix}NO\\K\end{matrix}\right\}O$
Water.	Potassic hydrate.	Hydric nitrite.	Potassic nitrite.

Potassic hydrate is water which has one of its atoms of hydrogen replaced by an atom of potassium; hydric nitrite is water which has one atom of hydrogen replaced by nitric oxide; and potassic nitrite is water with one of its hydrogen atoms replaced by nitric oxide, and the other by potassium. This speculation, as every chemist knows, is well supported by experiments; it embraces three large classes of bodies which, till then, had been considered as distinct. M. Gerhardt, in 1853, extended Williamson's views, by distinguishing two other types of molecular structure, represented, respectively, by hydrogen and ammonia, and succeeded, by help of the radical theory, in arranging the majority of the then known substances under one or the other of the three types already mentioned.

Like every theory which is in harmony with experience, the above considerations led to results of unexpected importance; for it soon became apparent that the radicals which thus replace hydrogen in water are not all of the same chemical value. If we place together the formulæ of hydric nitrite and carbonic acid—

$\left.\begin{matrix}NO\\H\end{matrix}\right\}O$	$CO\}O$
Hydric nitrite.	Carbonic acid.

we perceive, at once, that the atomic group NO has replaced one atom of hydrogen in one molecule of water, and carbonic oxide, CO, two atoms of hydrogen in one molecule of water. Nitric oxide (NO) is, therefore, said to be equivalent to one atom of hydrogen, and carbonic oxide (CO) equivalent to two atoms of hydrogen. The radical of phosphoric acid [PO] is found to be equivalent to three atoms of hydrogen. Professor Odling was one of the first to observe this difference in the equivalence of atoms, and groups of atoms, or compound radicals, as they are termed, a difference which he marks, as shown in the following examples:—

Radicals.

Equivalent to one atom of hydrogen.		Equivalent to two atoms of hydrogen.	
Nitric oxide	$(NO)'$	Carbonic oxide	$[CO]''$
Methyl	$(CH_3)'$	Methylene	$[CH_2]''$
Ethyl	$(C_2H_5)'$	Ethylene	$[C_2H_4]''$

The notion of equivalence enabled Professor Kekulé to form most interesting speculations on the constitution of organic bodies, and to explain the relation between composition and equivalence of such radicals as methyl, CH_3, ethyl, C_2H_5, methylene, CH_2, ethylene, C_2H_4, and acetylene, C_2H_4.

If from one molecule of marsh-gas, CH_4, one atom of hydrogen is abstracted, the residue, CH_3, called methyl, can combine with an atom of hydrogen again, and produce the original marsh-gas molecule. But methyl, instead of combining with an atom of hydrogen, can unite with an atom of chlorine, or an atom of bromine—that is to say, the place of the atom of hydrogen can be taken by an atom of chlorine or bromine. Methyl being thus equivalent to an atom of hydrogen, is said to be monovalent. If from a molecule of marsh-gas two atoms of hydrogen are removed, the residue, CH_2, called methylene, can again unite with two atoms of hydrogen, or, instead of hydrogen, two atoms of chlorine or bromine, and from the compounds CH_4, $CHCl_2$, CH_2Br_2 respectively. Methylene, therefore, being equivalent to two atoms of hydrogen, is termed divalent. The radical CH, left after the abstraction of three atoms of hydrogen from marsh-gas, is able to reproduce with three atoms of hydrogen one molecule of marsh-gas, or to combine with three atoms of chlorine, and form chloroform, $CHCl_3$. The residue, CH, is thus trivalent or equivalent to three atoms of hydrogen. In the same manner carbon is found to be tetravalent or equivalent to four atoms of hydrogen. But carbon, formen [CH], methylen, CH_2, methyl, CH_3, not only combine with hydrogen, chlorine, or other elements according to their equivalence, but also amongst themselves, and thus produce the so-called hydrocarbons, native as well as artificial. Methyl combines with methyl and produces dimethyl, or better known as ethylic hydride, $CH_3+CH_3=C_2H_6$; methylene combines with methylene, and forms ethylene, $CH_2+CH_2=C_2H_4$. Methylene is divalent, and methyl nonavalent; therefore methylene combines with two equivalents of methyl and forms propylic hydride, C_3H_8, $CH_2+2CH_3=C_3H_8$. Six equivalents of formen are supposed to be contained in benzol $[C_6H_6]$, $6CH=C_6H_6$.

What has been said of marsh-gas also applies to ammonia and water. Ammonia, NH_3, minus one atom of hydrogen, forms the monovalent radical, NH_2, minus two atoms of hydrogen, the divalent radical, NH, and nitrogen itself trivalent, that is to say, it can replace three atoms of hydrogen in compounds, or can combine with three atoms of hydrogen. Water minus one atom of hydrogen produces the monovalent radical hydroxyl, HO, and water without both atoms of hydrogen gives us divalent oxygen. These radicals, NH_2, NH, N, HO, and O, can combine with each other, and with methyl, methylene, formen, and carbon respectively in different proportions. Thus methyl, methylene, and hydroxyl are contained in common alcohol. The union of methyl, carbon, oxygen, and hydroxyl gives acetic acid, $C_2H_4O_2$,

$$CH_3+C+O+HOC_2=H_4O_2.$$

Glycocoll is considered as a combination of methylene amidogen $[NH_2]$, carbon, oxygen, and hydroxyl:—

$$CH_2+NH_2+C+O+HO=C_2H_5NO_2=\text{glycocoll.}$$

The radicals C, CH, CH_2, CH_3, HO, O, N, NH, NH_2, and CO, are considered to form the proximate constituents of the most important organic compounds. It often happens that, from the union of the same radicals, two or more bodies of the same composition, but differing from one another in properties, result. Glycocoll, as well as glycolamide, contain the radicals methylene, hydroxyl, carbonic oxide, and amidogen, NH_2. In such cases the nature of the compound depends on the arrangement of the radicals, as may be seen by the following formulæ:—

$$CH_2.NH_2.CO.HO=C_2H_5NO_2=\text{glycocoll,}$$
$$CH_2.HO.CO.NH_2=C_2H_5NO_2=\text{glycolamide.}$$

Now, the great problem with whose solutions scientific chemists are occupied, is *to determine, first, what sort of radicals of the above nature are contained in a given organic body; and, second, how these radicals are grouped amongst each other.*

There are several ways of solving this problem. The molecule may be built up by placing the radicals which are supposed to exist in it under suitable conditions in contact. Two molecules of iodopropionic acid placed together with metallic silver will lose their

iodine, and the residues of the two molecules remain united. A new acid, called adipic acid, is thus formed.

$$\text{Iodopropionic acid} \begin{cases} CO.HO \\ CH_2 \\ CH_2I \end{cases} + Ag = 2AgI + \begin{cases} COHO \\ CH_2 \\ CH_2 \\ CH_2 \\ CH_2 \\ COHO \end{cases} = \text{adipic acid.}$$

$$\text{Iodopropionic acid} \begin{cases} CH_2I \\ CH_2 \\ COHO \end{cases}$$

We know, therefore, the radicals of adipic acid and their arrangement if we possess the same knowledge with regard to iodopropionic acid.

The above elegant synthesis has lately been performed by Professor Wislicenus of Zurich. M. Berthelot has now succeeded in producing representatives of the principal classes of hydrocarbons from the element of carbon and hydrogen, and Messrs. Bauer and Versow of Vienna have prepared from amylene, C_5H_{10}, a compound, $C_{10}H_{16}$, which appears to be identical with terebene, a body closely allied to turpentine.

Another way to determine the proximate constituents of molecules is to take the little structures to pieces and to form a judgment of their constitution from the radicals which thus can be extracted. This plan has been adopted by Mr. Chapman, and described by him at one of our former meetings.

The more common and more reliable method for the determination of the grouping of atoms in molecules is, however, the replacement of one or more of them by atoms of another kind, and the careful examination of the properties of the bodies thus formed. M. Gautier has recently obtained a new substance of the same composition as acetonitrile, which he calls methcarbylamine. According to their formation, acetonitrile, as well as methcarbylamine, can be considered as combinations of cyanogen and methyl=CH_3CN. The two bodies, however, do not possess the same properties. If they are heated with potassic hydrate and water, methcarbylamine produces formic acid and methylia, whereas the same reagents cause acetonitrile to form acetic acid and ammonia. Thus—

$$\underbrace{C_2H_3N}_{\text{Acetonitrile.}} + \underbrace{2H_2O}_{\text{Water.}} = \underbrace{C_2H_4O_2}_{\text{Acetic Acid.}} + NH_3$$

$$\underbrace{C_2H_3N}_{\text{Methcarbylamine.}} + 2H_2O = \underbrace{CH_2O_2}_{\text{Formic Acid.}} + \underbrace{N\begin{cases} CH_3 \\ H \end{cases}}_{\text{Methylia.}}$$

In the first case, the radical methyl remains after the decomposition in union with carbon, and in the second case in combination with nitrogen. Accordingly, it is supposed that the same arrangement prevails in the undecomposed molecules, and with this supposition all the other properties of methcarbylamine and acetonitrile agree. In symbols these relations are expressed as follows:

$$N\begin{cases} C'' \\ CH_3 \end{cases} = \text{methcarbylamine.}$$

$$N\{C_2H_3 = \text{acetonitrile.}$$

This case of isomerism is most interesting, inasmuch as it furnishes a most instructive lesson on the grouping of atoms. The homologous bodies of methcarbylamine in the ethyl and propyl series have also been obtained.

Isomerism, indeed, has received much attention during the last year, and a great many interesting discoveries have resulted. Of these, one more exam- may be mentioned. We know two compounds formula CN_2H_4O—the one is ammonic cyanate, and the other urea. Until recently, only one corresponding sulphur-compound, ammonic sulphocyanate, was known. Professor Reynolds has succeeded in obtaining the true sulphur-urea, a body isomeric to ammonic sulphocyanate.

Thus every year produces results which improve our conceptions of the atomic and molecular constitution of bodies. And, as our knowledge improves, new questions suggest themselves, and our power over the elements increases. It has already become possible to prepare, in the laboratory, bodies of a very complex character, and which, a few years ago, were only found in the bodies of animals or plants.

Alizarine, the beautiful compound of the madder root, has been obtained, by artificial means, in the course of the year, by MM. Liebermann and Græbe. Results of such a nature render it highly probable that, at no distant period, it will be in our power to render nearly all, if not all, the substances found in plants and animals. Here I must not be misunderstood. Organic structures, such as muscular fibre, or the leaves of a tree, the science of chemistry is incapable of producing; but molecules like those found in a leaf, or in the stem of a tree, will, no doubt, one day be manufactured from their elements.

I must not conclude this address without reference to two or three papers of great importance.

Professor Bunsen, of Heidelberg, has published a paper on the washing of precipitates. Every one acquainted with practical chemistry knows how much time is often lost in waiting for a liquid to pass through a filter. Bunsen found the rate of filtration nearly proportional to the difference between the pressures on the upper and lower surfaces of the liquid. If, accordingly, the funnel be fixed air-tight, by means of a perforated cork, to the neck of a bottle, and the air exhausted in the bottle, the liquid will run faster through the filter in proportion to the diminution of the pressure in the bottle. Comparative experiments, some made according to the old, and others according to the new method, showed that the filtration, washing, and drying of the precipitate, which took seven hours by the old plan, could be performed, by filtration into an exhausted bottle, in thirteen minutes. But a saving of time is not the only advantage of the improved method of collecting and washing precipitates. A more perfect washing, with less water than is required by the common way of proceeding, is by no means the least recommendation of Bunsen's ingenious method.

A very important paper has been published by Professor Liebig, on the improvement of the nourishing qualities of bread. Certain quantities of phosphates and other salts form necessary ingredients of wholesome food. Now, it is well known that most of these salts, which are naturally in wheat, remain with the husk. Liebig proposes to add salts, of a nature similar to those remaining in the husk, to the flour, and, at the same time, to substitute, for the carbonic acid developed by fermentation, gas liberated from iodic carbonate. The bread prepared according to Liebig's recommendation is said to be of excellent quality, and to exceed bread made by the common plan in value.

Mr. Graham, of Her Majesty's Mint, has continued his researches on the absorption of hydrogen by palladium. Palladium appears to be able to absorb more than 900 times its volume of hydrogen, and to form a combina- nal equivalents of the Graham calls the

combined hydrogen, acts in this case like a metal, and thus the opinion held by some scientific men, that hydrogen constitutes the vapor of a metal, receives confirmation. The specific gravity of hydrogenium, as contained in the alloy, was found to be 1·95. These experiments are remarkable in more than one respect. The palladium which absorbs and combines with the hydrogen, does not change its state of aggregation, but remains solid, and expands, as if it had been heated. The nodules of the palladium have, consequently, changed their relative positions, and combined with hydrogen, whilst the continuity of the metal remained intact.

The last paper to which I have to draw your attention, is to the beautiful paper by Professor Tyndall, on a new method of decomposing gaseous substances by means of light. Tyndall's experiments bring us face to face with the motions of atoms of molecules, and the relation of these motions to chemical decomposition. They will, no doubt, at some future time, furnish valuable materials to chemical dynamics.

PRELIMINARY REPORT OF THE COMMITTEE APPOINTED FOR THE

DETERMINATION OF THE GASES EXISTING IN SOLUTION IN WELL WATERS.*

BY DR. E. FRANKLAND, F.R.S., AND HERBERT McLEOD, F.C.S.

In consequence of the investigation being far from complete, this report must be considered as merely a preliminary one; a more detailed account of the results obtained and the inferences to be drawn from them must be postponed till a future occasion.

The apparatus employed in these and other experiments was described at the last meeting of the Chemical Society, and will shortly be published in the *Journal*.†

In collecting the waters, it is, of course, of the greatest importance that they should be prevented from coming in contact with the air, otherwise serious errors might be produced in the determination of the gases dissolved. In order to avoid these errors, the tap delivering the water from the pumps is connected, by means of a caoutchouc tube, with a tubulure at the bottom of a tin cylinder, about 10 inches high, and 7 in diameter. The water is turned on, and allowed to flow over the edge of the vessel; thus only the surface of the water is exposed to the action of the air, and the liquid at the lower part of the vessel is protected by the upward current and continual overflow.

The bottles used for collecting the waters hold a little more than 100 c.c., and a separate quantity is used for each experiment. Into each bottle a piece of glass tube bent in the form of a U is introduced; one end of the tube is sealed, and, in the closed limb, a bubble of air is confined by mercury, which fills the open limb and the bend. In the collection of each water, four of these bottles are lowered, by means of pieces of string, into the tin vessel while the water is flowing over its edge. After being filled, each bottle is carefully examined, and, if any bubbles of gas adhere to the sides, they must be removed. The bottles are then again lowered into the vessel, and the temperature observed. A syphon is now passed to the bottom of one of the bottles, and, after it has drawn two or three hundred cubic centimetres of water through the bottle, it is placed into the second. The first bottle is now raised, and, while its neck is still under the water, a slightly-greased stopper is put into the neck, and carefully pressed down. This force compresses the air contained in the glass tube, and, if the pressure is sufficient, it prevents the escape of gas from the water—a precaution which, in some cases, is very necessary. The sy-

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
	Rain-water.	Water from cistern of Royal College of Chemistry, supplied by Grand Junction Company.	Water from well, in chalk, 367 ft. deep, at Messrs. Barclay and Perkins's Brewery, Southwark.	Water from well not down to chalk, in course of construction, 143½ ft. deep, at Messrs. Barclay and Perkins's Brewery, Southwark.	Water from chalk well at Worthing.	Water from surface well to face of the chalk, 27—30 ft. deep, at Mr. Hill's Brewery, Deal. In the town. Influenced by the tide.	Water from chalk well 115 ft. deep. Waterworks, Deal, surrounded by cultivated fields. Not influenced by tide.	Water from Waterworks, Deal, drawn from main about a mile from the reservoir.
Temperature at time of collection (° C.)	15·5	14·8	12·1	12	(?)	11·9	14·8	17·2
Mean of	2 expts.	2 expts.	2 expts.	4 expts.	2 expts.	2 expts.	2 expts.	2 expts.
Volumes of gases in 100 volumes of water. Nitrogen	1·382	1·397	2·030	1·973	1·552	1·704	1·548	2·241
Oxygen	0·673	0·620	0·029	0·018	0·446	0·023	0·580	0·796
Carbonic anhydride	0·135	4·239	5·765	3·814	5·452	10·252	5·055	4·413
Total	2·190	6·256	7·824	5·805	7·450	11·979	7·183	7·450
Solubility of nitrogen in 100 volumes of distilled water (Bunsen)	1·468 at 15·5°	1·478 at 15°	1·549 at 12°	1·549 at 12°	—	1·549 at 12°	1·478 at 15°	1·441 at 17°

The experimental results, of which the above numbers are the means, were tolerably concordant. The greatest differences between the results of different experiments are the following:—In water No. IV., experiment 3 gave 0·140 parts more nitrogen than experiment 2; in water No. VII., the oxygen obtained in the second experiment was 0·045 in excess of the quantity obtained in the first; in water No. III., the second experiment gave 0·760 parts more carbonic anhydride than the other. Since this last was done, the mode of collection and removal of the gases have been improved.

* Read before the British Association, Exeter meeting, Section B.

† See Chemical News, vol. xx., p. 20 (*Am. Repr., Sept.*, 1869, *page* 158).

phon is then transferred from the second into the third bottle, and the second is closed and removed. When the four bottles have been filled, the stoppers are covered with ground caps. The caps are next filled with mercury, through small holes at their tops, which are afterwards closed with glass stoppers.

The gases should be removed from the waters as soon after collection as possible. In the following cases, the greatest length of time which was allowed to elapse between these operations was five days; but usually the removal of the gases was effected the day after the collection.

With so few results as have been obtained up to the present, it will be impossible to do more than point out the small quantity of oxygen in the waters from deep wells as compared with those from shallow ones, and with rain and river waters. The quantity of nitrogen is also very remarkable as being, in all the cases, except the river and rain waters, in excess of the amount absorbable by distilled water. To show this, there is introduced into the foregoing table numbers from Bunsen's gasometry, indicating the quantities of nitrogen absorbable by 100 volumes of distilled water at the temperatures which are nearest to those at which the waters were collected. The reasons of this apparent anomaly will be investigated during the course of the ensuing year, and it is hoped that, by the next meeting of the Association, a much larger amount of information will have been obtained. The prosecution of the experiments has been much hindered by the necessity of perfecting the apparatus for the removal of the gases and the means of collection, so that it was not until after the commencement of July that any systematic work could be commenced.

REPORT ON THE CHEMICAL NATURE OF CAST-IRON.*

BY MESSRS. F. A. ABEL, F.R.S., D. FORBES, F.R.S., AND A. MATTHIESSEN, F.R.S.

THE Committee have to report that, during the past year, some material progress has been made in this research. They entrusted the preparation of pure iron to Dr. Matthiessen, who carried out this part of the investigation in conjunction with M. Prus-Szczepanowski. From a series of experiments, which are detailed in the Appendix, pure iron appeared to be obtainable in considerable quantities; and we hope, if the Committee be re-appointed, that next year a great deal of valuable information will be obtained on the chemical nature and physical properties of pure iron and its alloys. The iron obtained by the process described in the Appendix is almost absolutely pure, containing only a minute trace of sulphur. According to an analysis made by Professor Abel, the iron contained, in 100 parts, only 0·00025 parts of sulphur. In another analysis, the amount of sulphur found by M. Prus-Szczepanowski amounted to 0·0007 per cent. Phosphorus and silicon were carefully tested for by both analysts, and found to be entirely absent. The amount of substance taken for each analysis was about 30 grammes.

APPENDIX.

ON THE PREPARATION OF PURE IRON.

BY A. MATTHIESSEN, F.R.S., AND S. PRUS-SZCZEPANOWSKI.

AFTER numerous trials, the general outline of which was given in the report of last year, the following method was found to yield nearly absolutely pure iron, in quantities sufficient for the purpose of this research. Pure dried ferrous sulphate, and pure dried sodium sulphate, are mixed in nearly equal proportions, and introduced gradually into a red-hot platinum crucible. The mass is kept in fusion until the evolution of sulphurous acid gas ceases. The crucible is then allowed to cool, and the fused mass extracted with water. If the heat be properly regulated, the whole of the iron is left as a very fine crystalline oxide. This oxide is thoroughly washed, by decantation, to remove every trace of the sodium sulphate, and, after being dried, is reduced, by hydrogen, in a platinum crucible; the spongy iron thus obtained is then pressed into solid buttons, and melted in lime crucibles with the oxyhydrogen blowpipe.

Before proceeding further, it will be as well to mention the precautions observed in obtaining the raw material in the purest state. The commercial pure ferrous sulphate was freed from every trace of copper by leading sulphuretted hydrogen through the warm acetic acid solution. After filtration the ferrous sulphate was twice re-crystallised, and dried, first in a water-bath, then in an air-bath. The commercial crystallised sodium sulphate was re-crystallised several times to get rid of the last trace of chloride of sodium, and then heated on a water-bath to melt the crystals. As is well-known, anhydrous sodium sulphate separates out from this solution, which was scooped out from time to time, dried on an air-bath, and powdered. The purification of the sodium sulphate from chloride of sodium was found to be necessary, owing to the fact that when fusions were made with sodium sulphate containing that salt, the resulting oxide of iron always contained platinum. The hydrogen used for the reduction of the iron, as well as for the blowpipe, was prepared by the action of sulphuric acid on zinc, and purified by leading the gas through two wash bottles—the first containing nitrate of silver and strong nitric acid, and the second caustic soda and acetate of lead—both bottles being half filled with pieces of pumice-stone. The oxygen was prepared by heating a mixture of chlorate of potassium with 15 to 20 per cent of black oxide of manganese, and washed by leading through caustic soda. All connections were made of glass, lead, or pure india-rubber tubing.

The fusion took place in a large platinum crucible (the contents of which are rather more than ½ a litre), enclosed in the usual manner in a clay crucible. The dimensions were such, therefore, that about a kilo. and a half of the mixture could be fused at each operation. After fusion, the crucible is allowed to cool; it is then boiled out with distilled water, and the accumulated product of 6 to 8 fusions washed by decantation with boiling distilled water. The crystalline oxide settles very quickly, and thus allows of a very rapid and thorough washing. The washing was in every case continued several times after the wash waters ceased to give any turbidity with barium nitrate. It is worthy of mention that the above process to prepare pure oxide from the mixture of mixed sulphates yields the purest oxide we as yet obtained. The reduction of the oxide thus formed was made in a covered platinum crucible, heated by means of a large Bunsen burner. The hydrogen was introduced by means of a platinum tube, reaching through the cover to the bottom of the crucible. The gas, purified as described [illegible] calcium, was always

* Read before the British Association, Exeter Meeting, Section B.

kept slightly in excess, a constant stream of gas being obtained by not using the generator, but two large gas-holders joined together, the contents of each being about 600 litres (20 cubic feet); two other gas-holders of similar capacity being used for the storage of the oxygen, the one being used to collect the gas from the retort, the other to contain the gas purified by passing it through a strong solution of caustic soda.

The resulting spongy iron was pressed into solid buttons, by means of a strong coining press and a diamond mortar, the cylinder of which being about 70 m.m. in height, the iron, when pressed, forms a cylinder of about 15 m.m. in height, and weighs about 20 grammes. The melting of the compressed iron took place in lime crucibles, the lime having been previously burnt, slacked, and reburnt, thus forming a fine, impalpable powder, which was compressed in the crucible mould.

The best method of fusion was found to be as follows:—The lime crucible was placed in a slanting position on a piece of lime. One of the oxyhydrogen blowpipes used in the process played on the outside of the crucible whilst the flame of the other was directed inside. When white-hot, a cylinder of the compressed iron was thrown into it. It quickly melts, but at the expense of a large quantity of the iron which is oxidised. The amount lost by the oxidation varies between 25 to 50 per cent. In order to obtain a good solid button of melted iron, it is necessary to cool it in an atmosphere of hydrogen, which is easily obtained simply by turning off the oxygen from the blowpipe playing inside the crucible. The button thus obtained weighs about 15 grammes. On analysis, it was found that the buttons were free from sulphur, phosphorus, silicon, and calcium.

The preparation on a large scale of the pure ferrous sulphate and sodium sulphate was kindly undertaken for us by Mr. J. Williams, who prepared for us more than a hundred weight of each of these substances. We are also indebted to Mr. W. G. Underhay for the use of his large coining press for the pressing of the lime crucibles and the iron buttons.

THE ELECTRO-DEPOSITION OF IRON.

IN the Chemical Section of the British Association, Dr. JACOBI, so well known as the earliest worker in the field of electro-metallurgy, read a paper "*On the Electro-Deposition of Iron.*"

The paper was illustrated by a series of beautiful specimens; among these may be mentioned a medallion of the learned professor, 800 m.m. in diameter. The details of the process were not as full as could be desired. Dr. Jacobi stated that he preferred to employ a dilute solution of the double sulphate of iron and sulphate of potash, soda, or magnesia.

A very low battery power was employed—usually two small Smee's elements.

The moulds may be gutta-percha, wax, or, in fact, any material with which the electro-metallurgist is familiar.

Nature of the Deposit.—The iron has a beautiful lustre, and a silky texture. Exact experiments on its conductivity and tensile strength have yet to be made.

Employment of the Electro-Iron in the Arts.—As we have already stated, Dr. Jacobi showed specimens of great beauty of iron so deposited. Examples of mediæval art of extreme intricacy may be faithfully re-produced; the tone of the metal being well adapted for a purpose of such interest.

In addition to the above, there were many stereotypes. Examples of the process of heliography were illustrated by impressions taken from electro-deposited iron plates. To this process the form of metal is singularly applicable.

The patent rights have been secured; and the extreme importance of the process in a commercial point of view cannot be too strongly insisted upon.

In conclusion, we may mention the result of some curious experiments given by Dr. Jacobi.

A rod of wax was first coated with a thin film of copper, and on this the iron was deposited. The rod was surrounded by a helix of copper wire, through which a current of electricity was passed. The deposit of iron produced was magnetic, and the metal was deposited in fine fibres at the poles, the tube being of a fine, close texture. The fine particles of iron followed the lines of the magnetic curve.

It may also be stated that the electro-deposited iron possesses the power of occluding twenty times its volume of hydrogen gas. Dr. Jacobi stated that further experiments were necessary to confirm this.

ON A

REMARKABLE STRUCTURAL APPEARANCE IN PHOSPHORUS.*

BY CHARLES TOMLINSON, F.R.S., F.C.S.

THE following remarkable appearance in phosphorus was described to me some months ago by Mr. James John Field, F.C.S., who requested me, if possible, to account for it:—

About four years ago, Mr. Field placed about half a dozen sticks of phosphorus in a cylindrical jar containing water, which rose about ½ an inch above the ends of the sticks, and the jar was closed with a bung. This jar was placed in a cellar, where it remained undisturbed for about three years. The cellar is flagged with stone, is surrounded by damp walls, and almost entirely protected from light and currents of air. The maximum temperature probably did not exceed 50° or 55° Fahr.

After this long repose, the jar was taken into the laboratory, when it was found that the level of the water had sunk to about one-third of its original height, and the liquid left in the jar had become as dense and thick as the strongest syrup; it consisted of a solution of PO_3 and PO_5.

The portions of phosphorus that rose some inches above the liquid, instead of being cylindrical as before, were conical, from a sharp point to the full diameter, and each cone had a double spiral running down from left to right, as if two flat tapering bands of the substance had been made to cohere at right angles lengthwise, and then twisted into pointed rods, or just as if the sticks had been mounted in a screw-cutting lathe, geared to cut a coarse, tapering double spiral. The sticks had also changed from the creamy, opaque surface to a translucent, barley-sugar appearance, from the surface of the liquid up to the points.

In attempting to explain the appearances described, we must consider—*first*, the wasting away of the sticks, and their conical form; and, *secondly*, the twisted structure.

First. The wasting away of the sticks, and their

* Read before the British Association, Exeter meeting, Section B.

conical form, are clearly effects of slow combustion, diminishing in intensity downwards. The continued combustion, and also the evaporation of the water, must have been due to a badly-fitting cork, which, during a falling barometer, allowed a portion of the moist air to escape from the jar, and, during a raising barometer, allowed a portion of comparatively dry air to stream in. Had the jar been subject to considerable variations in atmospheric temperature, the effects would have been more rapid; but, as the temperature of the cellar was pretty constant, there is nothing to detain us here. Going back, then, to variations in atmospheric pressure, the level of the water in the jar would be gradually lowered during the oscillations of the barometer, until at length the tops of the sticks of phosphorus became exposed. Slow combustion would then set in; the resulting acid would go into solution, and small quantities of fresh air would stream in to supply the partial vacuum, and so continuet he action. During a falling barometer, nitrogen and moisture would stream out of the jar, the level of the water would be again slightly lowered, and a fresh portion of phosphorus be exposed to the attack of the next portion of oxygen drawn in. In this way, by very slow degrees, the liquid would be lowered, and fresh portions of phosphorus exposed. Those already out of the water would be attacked by every ingress of air, and, thus being acted on, not only more energetically, but also for a longer time, than the lower portions, they would necessarily have a conical shape. Moreover, the air that streamed into the jar would gradually lose its oxygen in descending, so that the lower portions would be acted on less strongly than the upper. The phosphoric acid, as generated, would also pass into solution with a certain rise of temperature, and a certain expansion of the nitrogen left in the jar. As this cooled down, a little more air would be drawn in, and combustion and solution would go on as before. But the most energetic action would be made when, under a falling barometer, a quantity of moist nitrogen streamed out of the jar; and, during a rising barometer, a fresh supply of atmospheric air streamed in, as already explained.

Secondly. As to the spiral markings: these cannot have been formed by any action that took place in the jar; but they show, I think, the new and interesting fact that the curves which the theory of hydraulics assigns to liquids flowing from an orifice, and producing the *vena contracta*, actually form part of the structure of a body suddenly arrested in its flow by being made solid.

It is well known that, in the ordinary manufacture, phosphorus is formed into sticks by being made to flow from a *head* or reservoir of the molten element along a short pipe or *ajoutage* into cold water—or, rather, as soon as the stick of phosphorus begins to emerge from the warm *ajoutage*, and shows itself in the cold bath, it is seized by hand, and cut off at intervals, or drawn out by machinery into a continuous length, so that from 15 to 20 lbs. and upwards of phosphorus can be moulded in less than a quarter of an hour.

Now of course in the flow of the molten phosphorus Torricelli's theorem applies—viz., that particles of a fluid, on escaping from an orifice, possess the same velocity as if they had fallen freely *in vacuo* from a height equal to that of the fluid surface above the centre of the orifice. If the head of phosphorus were not too deep, there would be seen immediately over the orifice a hollow depression, which increases and becomes a cone, or funnel, the centre of which is in the orifice, and the liquid flows in lines directed towards the centre. In this condition of the liquid, a rotatory motion is necessarily imparted to it, and this rapidly increases, because all the particles are approaching the centre, and, by virtue of their inertia, they tend to maintain the same velocity which they had in a larger circle, so that their angular velocity (or the number of revolutions in a given time) is constantly being increased. As the particles approach the orifice, they converge to a point beyond it, so that the liquid in escaping is narrower or more contracted at the point to which it converges, than it is either before it arrives at that point or after it has passed it. But, as this point in the phosphorus to which the rotatory lines converge, though fixed in or near the tube, is being constantly shifted in the phosphorus by being drawn out and moulded in the tube, the converging lines, also, are drawn out, and thus give the appearance of a double spiral. Of course, some of the lines are obliterated by the moulding action of the tube, and are probably of a different texture as to hardness as compared with the drawn-out lines. These flattened or moulded portions first yield to the action of slow combustion, and leave the harder drawn-out lines in relief.

ON THE

MEASUREMENT OF GASES AS A BRANCH OF VOLUMETRIC ANALYSIS.*

BY W. J. RUSSELL, PH.D.

LECTURER ON CHEMISTRY AT ST. MARY'S HOSPITAL MEDICAL SCHOOL.

At present, the measurement of the amount of gas given off during a reaction has been but little, if at all, used as a means of quantitative analysis. This has arisen from the want of some simple and easy way of collecting the gas evolved. In a paper read before the Chemical Society last year, I showed how carbonates might, with very considerable accuracy, be estimated in this way; and, since then, I have used the same method for determining the atomic weights of nickel and cobalt. This form of volumetric analysis is of more general application than might at first sight appear probable, and will, it is believed, in certain cases, be found of considerable importance. Having no standard solutions to prepare and keep in order is an obvious advantage; the gas apparatus, once in order, is then always ready for any kind of analysis in which gas is evolved; the reactions made use of, as a rule, take place rapidly; and the volume of gas, as far as the measurement of it is concerned, can be effected with very considerable accuracy. The amount of material used is generally very small, and the whole analysis occupies but a very short time, and can be very easily performed.

The form of apparatus used for collecting and measuring the gas has been already described in the *Journal of the Chemical Society* for August of last year. The following analyses, which have been made by this process, may be of interest as illustrations of the method:—

When carbonic acid is the gas evolved, it is obviously necessary to have as small a quantity of liquid present as possible, to prevent loss by absorption. A specimen of calc spar, which, theoretically, should contain 44·00 per cent of CO_2, gave, when dissolved in a mixture of two acid and one part of water:—

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1st experiment,	43·93	per cent	of	CO_2.
2nd "	43·92	"	"	
3rd "	43·90	"	"	
4th "	43·97	"	"	
5th "	43·89	"	"	

Another specimen, dissolved in two parts of hydrochloric acid and one part of water, gave:—

1st experiment,	43·89	per cent	of	CO_2.
2nd "	43·90	"	"	
3rd "	43·90	"	"	
4th "	43·84	"	"	
5th "	43·90	"	"	
6th "	43·85	"	"	

In all these experiments, 1·2 c.c. of the dilute acid were used.

Some pure sodic carbonate, dissolved in 1·3 c.c. of two parts of water and one part of hydric sulphate, gave 41·48, 41·52, and 41·50 per cent. of CO_2. Theoretically, 41·51 per cent. should have been obtained.

An experiment with hydric chloride, instead of hydric sulphate, gave 41·52.

The strength of any acid is easily estimated by simply reversing this process, that is, taking a known weight of the acid and an excess of carbonate.

The reaction which takes place when manganic peroxide is heated with sodic oxalate and hydric sulphate, serves for the estimation of the amount of manganic peroxide present, every atom of oxygen liberated corresponding to two atoms of carbonic acid. A specimen of manganese gave—

1st experiment,	58·16	per cent.	of	MnO_2.
2nd "	58·10	"	"	

A specimen of potassic permanganate, dried at 100°, gave the following results (100 parts of permanganate yield 139·24 of CO_2):—

1st expt. found	136·70,	corresponds to	98·17	p.c.	$K_2Mn_2O_8$.
2nd "	136·00	"	97·69	"	"
3rd "	136·63	"	98·13	"	"

Potassic bichromate is another salt which can be easily analysed in the same way, by heating with the sodic oxalate.

Potassic bichromate yields 89·49 per cent of CO_2; a specimen of the salt gave—

1st expt.,	88·48 p.c. CO_2,	corresponds to	98·87	$K_2Cr_2O_7$.
2nd "	88·57 "	"	98·97	"

The same specimen, more strongly dried, gave—

1st expt., 88·62 p.c. CO_2, corresponds to 99·03 $K_2Cr_2O_7$.

Interesting and important results may be obtained by dissolving metals in acids, and measuring the volume of hydrogen evolved. A specimen of zinc dissolved in dilute hydric chloride gave—

1st expt.,	3·053	p.c. H,	corresponds to	99·22	p.c. zinc.
2nd "	3·051	"	"	99·16	"
3rd "	3·050	"	"	99·13	"

A specimen of electro-deposited zinc, which had been subsequently fused, given to me by Mr. Walenn, gave—

1st expt.,	3·060	p.c. H,	corresponds to	99·45	p.c. zinc.
2nd "	3·054	"	"	99·26	"

Another specimen of electro-deposited zinc gave—

1st expt.,	3·032	p.c. H,	corresponds to	98·55	p.c. zinc.
2nd "	3·033	"	"	98·57	"
3rd "	3·033	"	"	98·57	"

0·1832 grm. of the commercial powdered zinc was dissolved; it gave a volume of hydrogen corresponding to only 81·98 p.c. of metallic zinc. A specimen of what is sold as pure powdered zinc gave hydrogen corresponding to only 69·22 per cent. of zinc.

With nickel and cobalt, the same process is applicable, and has been used for determining their atomic weights. The results have been communicated to the Chemical Society, and will be published in the *Journal* of the Society.*

The following results have been obtained with different specimens of iron:—

Dr. Matthiessen gave me what he believed to be a specimen of pure iron; it gave—

1st expt.,	3·571	p.c. H,	corresponds to	100·00	p.c. iron.
2nd "	3·568	"	"	99·93	"

Steel piano-wire (No. 10) gave—

1st expt.,	3·444	p.c. H,	corresponds to	96·45	p.c. iron.
2nd "	3·445	"	"	96·49	"

Some of the same wire was dissolved, and the amount of iron estimated by Penny's process.

1st expt. gave	97·8	p.c. iron.
2nd "	98·2	"

Mean.

Hydrogen process, 96·47. Penny's process, 98·00

This gives a suppression of hydrogen corresponding to 1·53 per cent. of iron.

Cast-iron filings gave—

1st expt.,	3·375	p.c. H,	corresponding to	94·50	p.c. iron.
2nd "	3·366	"	"	94·27	"

When tested by Penny's process, the filings were found to contain 97·0 per cent. of iron; this gives a suppression of hydrogen corresponding to 2·62 per cent. of iron.

A specimen of gray crystalline pig-iron gave, when dissolved, a volume of hydrogen corresponding to only 89·04 per cent. of iron.

A piece of magnesium ribbon evolved an amount of hydrogen corresponding to 99·18 per cent. of metal.

The foregoing results will serve simply to indicate the kind of results which have been obtained by this form of volumetric analysis.

ON JARGONIA.†

BY H. C. SORBY, F.R.S.

I HEREWITH send, for exhibition at the Chemical Section, what I believe to be nearly pure zirconia, and jargonia prepared by a modified combination of the methods described by Mr. David Forbes and myself. You will notice, at once, that the zirconia is perfectly white, whereas the jargonia is of a clear straw-colour. This exactly corresponds with the difference between the opaque borax blowpipe-beads heated to redness, as described in my paper in the *Proceedings of the Royal Society*, and I am strongly inclined to believe that it is a characteristic peculiarity. At first I thought it might be due to the presence of a small quantity of iron, since zirconia, containing a little of the peroxide, is of a similar yellow colour. When, however, that is digested in sulphide of ammonium, it quickly turns to a deep green

* See Chemical News, vol. xx., p. 20. *Am. Repr., Sept.*, 1869, *page* 158.

† Extract from a letter to Mr. Crookes, read before the Chemical Section of the British Association, Exeter meeting.

colour; whereas this yellow jargonia does not turn at all green. Subsequent experiments may show that the colour is due to some other substance; but, taking all the facts now known into consideration, it seems extremely probable that, after ignition, jargonia is of a clear straw-colour, paler than that of tungstic acid, but deeper than that of ceroso-ceric oxide.

The following is a complete list of the papers which were brought before Section B (Chemical Science) at the Exeter Meeting:—

Herbert McLeod.—*Report on the Determination of the Gases Existing in Solution in Well Waters.*

A. Matthiessen.—*Report of the Committee on the Chemical Nature of Cast-Iron.*

M. Jacobi.—*On Electrolytic Iron.*

J. Moffat.—*On the Phosphorescence of the Sea and Ozone in Connection with Atmospheric Conditions.*

J. Moffat.—*On the Oxidation of Phosphorus and the quantity of Phosphoric Acid Excreted by the Kidneys in Connection with Atmospheric Conditions.*

C. Tomlinson.—*On a Remarkable Structural Appearance in Phosphorus.*

B. H. Paul.—*Report on Treatment and Utilisation of Sewage.*

F. Braby.—*On Extraction of Ammonia from Gas Liquor.*

Stevenson Macadam.—*On the Economic Distillation of Gas from Cannel Coal.*

Walter Weldon.—*On the Manufacture of Chlorine by means of Perpetually Regenerated Manganite of Calcium.*

T. L. Phipson.—*On some New Substances Extracted from the Walnut.*

T. L. Phipson.—*On the Solubility of Lead and Copper in Pure and Impure Water.*

W. J. Russell.—*On the Measurement of Gases as a Branch of Volumetric Analysis.*

C. Tomlinson.—*On the supposed Action of Light on Combustion.*

Crace Calvert.—*On the Amount of Soluble and Insoluble Phosphates in Wheat Seed.*

H. Sorby.—*On Jargonia.*

S. Williams.—*On the Action of Phosphoric-chloride on Hydric-Sulphate.*

J. Dewar and G. Cranston.—*On Some Reactions of Chloro-Sulphuric Acid.*

A. Matthiessen and C. R. A. Wright.—*On the Action of Hydrochloric Acid on Morphia and Codeia.*

T. Andrews.—*On the Absorption Bands of Bile.*

M. Janssen.—*Methode Spectrale pour la recherche des Composés du Sodium.*

M. Janssen.—*Sur le Spectre de la Vapeur d'Eau.*

W. C. Roberts.—*On a specimen of Obsidian from Java.*

W. D. Michell.—*Are Flint Instruments of the First Stone Age Found in the Drift?*

E. C. C. Stanford.—*A Chemical Method of Treating the Excreta of Towns.*

H. Bamber.—*On the Water Supplies to Plymouth, Devonport, and Exeter.*

P. Spence.—*On the Production of Higher Temperatures by Steam of 212° Fahrenheit.*

A. Oppenheim.—*On Bromo-iodide of Mercury.*

A. Oppenheim.—*On Benzoe-sulphuric Acid.*

Professor Jellett.—*On a Method of Determining with Accuracy the Ratio of the Rotating Powers of Cane Sugar and In-*

Dr. Fritsche.—*Notes on Structural Change in Block Tin.*—Communicated by W. C. Roberts.

H. Cooke.—*On the Registration of Atmospheric Ozone in the Bombay Presidency, and the Chief Causes which Influence its Appreciable Amount in the Atmosphere.*

J. Lowthian Bell.—*On the Decomposition of Carbonic Oxide by Spongy Iron.*

Report of the Committee for Recommending Increased Facilities for Scientific Investigations.—The following is the report of the "Committee for Recommending Increased Facilities for Scientific Investigations:"—Your committee, having sought the council of many of the most eminent men of science of the United Kingdom upon these questions, so far as it was found practicable to do so, and having carefully deliberated thereon, have arrived at the following conclusions:—I. That the provision now existing in the United Kingdom of Great Britain and Ireland is far from sufficient for the vigorous prosecution of physical research. II. It is universally admitted that scientific investigation is productive of enormous advantages to the community at large; but these advantages cannot be duly reaped without largely extending and systematising physical research. Though of opinion that greatly increased facilities are undoubtedly required, your committee do not consider it expedient that they should attempt to define categorically how these facilities should be provided for the following reason:—Any scheme of scientific extension should be based on a full and accurate knowledge of the amount of aid now given to science, of the sources from which that aid is derived, and of the functions performed by individuals and institutions receiving such aid. Your committee have found it impossible, with the means and powers at their command, to acquire this knowledge. A formal inquiry, including the inspection of records to which your committee have not access, and the examination of witnesses whom they are not empowered to summon, alone can elicit the information that is required, and, as the whole question of the relation of the state to science, at present in a very unsettled and unsatisfactory position, is involved, they urge that a royal commission alone is competent to deal with the subject. Your committee hold that this inquiry is of a character sufficiently important to the nation, and sufficiently wide in its scope, to demand the use of the most ample and most powerful machinery that can be brought to bear upon it. Your committee therefore submit, as the substance of their report, the recommendation that the full influence of the British Association for the Advancement of Science should at once be exerted to obtain the appointment of a royal commission, to consider—(1). The character and value of existing institutions and facilities for scientific investigation, and the amount of time and money devoted to such purposes. (2). What modifications or augmentations of the means and facilities that are at present available for the maintenance and extension of science are requisite; and (3). In what manner these can be best supplied.

Place of Meeting for Next Year.—At the meeting of the General Committee, on Monday last, it was decided that the meeting next year should be held in Liverpool, under the presidency of Professor Huxley, F.R.S., &c.

NOTICES OF BOOKS.

What is Matter? By an Inner Templar, Author of "More Light: a Dream in Science."

We are informed by his biographers that when the author of "The Raven" composed his extraordinary lecture on Cosmogony, he started by denying that the arcana of the universe can be explored by induction. He informed his imagination with the various results of science, and then "entered with unhesitating boldness, though with no guide but the divinest instinct, into the sea of speculation, and there built up of according laws and their phenomena, as under the influence of a scientific inspiration, his theory of nature."

But Poe, although a poet, was, in his lucid intervals, well aware of the difference between poetical speculation and hard scientific truth, and, with characteristic audacity and clearsightedness, dedicated his work "To those who feel, rather than to those who think." Poe's work was in perfect logical harmony with the rules he laid down for himself as a poet, and we therefore accept it. The work before us is in logical harmony with no laws human or divine, and we therefore reject it. When a man writes nonsense and, by publishing it, challenges criticism, it is our duty to consider whether, "though it be madness, there is method in it;" and we are forced to admit that there is method in the work before us—but not much.

When a man writes nonsense, we are also bound to consider the tone in which he writes it. If he offers us his views on the more difficult problems of the universe, and those views are obviously incorrect, still, if propounded modestly, and argued cleverly, we receive them for what they are worth, and are loth to handle their author too roughly. But the views of the author of "What is Matter?" are neither propounded modestly, nor argued cleverly, and we therefore do not feel bound to be specially lenient to him.

Doubtless the Inner Templar considers that to fairly review his book, we should analyse each chapter *seriatim* and disprove his arguments as they arise; this, however, is impossible. A long review of such a work would not only be unreadable but utterly useless, and we think that if we convict our author of want of modesty, of want of judgment, and of ignorance of the subject on which he writes, we have done as much as can be expected under the circumstances.

When a man feels that those problems which have puzzled the wisest of mankind are to him easy of solution, we can forgive him for being (for a short time) so elated as to be moved by a crowd of foolish impulses, and if, in addition, he finds that all physical phenomena, including the secret of the nature of matter, are to him as self-evident things, we can forgive him for believing himself the wisest of mankind. But, on the other hand, if we find him announcing almost incredible discoveries, as revelations from an angel, and describing the revealer and the manner of the revelation in language of that childishly pompous character which our American friends stigmatise as "high falutin," we begin to doubt whether such absolute want of judgment can co-exist with superhuman clearsightedness.

The first announcement of the work before us was contained in a pamphlet called "More Light," which we noticed a few weeks ago, and we feel bound, after again looking at it, to say that it was one of the silliest productions ever written; and yet *The Tablet* (we quote from the opinions of the press) considers itself bound to "do the writer the justice to say, that his brief narrative is pleasantly written, and constitutes a lively contribution to a class of works rarely attractive to any but scientific readers." We feel bound to do the writer of the notice in the *Tablet* the justice to say that the only redeeming point in his notice is the fact that he offers "no opinion as to the scientific value of this little treatise." In fact, it is most unpleasantly written, and constitutes anything but a lively contribution to a class of works rarely attractive to any readers whatever.

"What is Matter?" is a neat little octavo volume of 195 pages. It is excellently printed on good paper, and all rights are reserved.

The work is divided into three books, each of which is subdivided into chapters, and there is a very complete table of contents.

The first book is principally devoted to a sketch of the opinions of the principal philosophers of antiquity, and we need not say that the continual repetition of such names as Thales, Anaximenes, Diogenes, Heraclitus, Anaxagoras, Zenophanes, Pythagoras, Empedocles, Leucippus, Socrates, Plato, Aristotle, Epicurus, Zeno, &c., &c., gives an air of dignity to the work which we hasten to acknowledge.

In Chapter VII. we come to a discussion on the views of Faraday, and Dr. Daubeny is severely handled for deficiency of imagination, and prejudice, and we are told that "It is painful to notice how he clings to existing notions, and appeals to common sense." We shall show further on that the last mentioned fault of the lamented Professor is one which can never be justly urged against our Inner Templar. Our author is not nearly so dogmatic upon some of the questions he discusses as might be expected from the favoured pupil of Oriel (see "More Light" *passim.*) In examining the question as to whether interplanetary space is on vacuum or a plenum, Sir John Herschel is quoted as of opinion that the sun is in a continually excited electrical state, which may account for the tails of comets being always directed away from the sun. "But" says our author, "this loses a great deal of its force, as that which produces the plenum is ether; but when a vacuum is produced by experiment, it is always supposed that the vacuum is a plenum so far as the ether is concerned, for no pump has ever been constructed which touched that point, and, in fact, if the vacuum be not a plenum of ether, what becomes of the undulatory theory, for light passes through a vacuum, as is very clear, or we should not be able to see a light on the other side of the receiver, and it must on that theory have ether to be set in vibration. And if we suppose the vacuum to be a plenum of ether when the air is removed, we have had two plena occupying the same space, which, surely, is not orthodox; and if it be argued that the ether was hidden in the pores of the air, how is it that this ether continued to stay behind when the air was driven out? If, then, every vacuum must be a plenum of ether, as the undulatory theory requires, and electricity will not pass through such a vacuum; it seems clear that light and electricity differ greatly, for it appears that electricity requires *ordinary* matter for its medium, but light not. May not, then, electricity be regarded as a sublimating of ordinary matter, and light such matter sublimated? for electricity produces light, but it does not appear that light must necessarily produce electricity. Altogether, what with plena, and vacua, and ether, the subject is in as highly organised a state of confusion as the bitterest opponent of the undulatory theory could wish for."

We have made this long quotation solely that it may not be said that we have condemned a book without sufficient reason. Is it too much to say that the "highly organized confusion" is in the bewildered brain of the Inner Templar? The query as to whether electricity may not be regarded as a sublimating of ordinary matter, and light as such matter sublimated is charming, and will, we trust, be put to "Oriel" at his next meeting with our author.

We must, absolutely, make one more quotation. Our author, speaking of a ray of light proceeding from the sun, says, "Such a ray, I conceive, consists of a continuous stream of atoms travelling with different velocities, and at the same time revolving with different velocities upon axes at right angles to their line of projection. These particles are but ultimate atoms of the different forms of matter existing in our solar system, and, though so minute as to be beyond all power of weight, have, I doubt not, a considerable influence in renewing the energy which is being continually expended by our globe. This incessant pouring of millions upon millions of ultimate particles of the elements into our atmosphere, and into even the solid body of the earth, must, I think,

greatly assist in explaining not only the almost universal presence of sodium—doubtless the chief cause of the yellow rays of the sun—but the presence of many other forms of matter which exist to such an extent in the atmosphere that it has been remarked that, in a cubic yard of air, might be traced the presence of almost every elementary substance. And, again, in regard to the ocean, which occupies three-fourths of the surface of our globe, who can say that the floods of light poured into its depths ages ago, when the sun's power must have been much greater, not to mention its present influence, may not have had a great effect upon its constitution—we know how its temperature is affected—and greatly contributed to the presence of those metals—especially sodium—which are a part of its constitution?" When we remember that, in "More Light," our author distinctly asserts the original matter to be nothing revolving upon an axis, that he also, in this work, states that he regards light to consist of the ultimate atoms revolving upon axes, and that these atoms are beyond the power of weight because they are so small, and that the sodium in the sea is derived from the sun's rays, we think we have proved to every reasonable person that our author is devoid of judgment in general, and that he is ignorant of the subject upon which he writes. As regards his modesty, let us quote one more paragraph from the author's "conclusion." "I have not hesitated to take the heterogeneous mass of materials supplied by every eminent man from Thales to Kant, and out of it to construct an edifice which, harmonising in all its parts, will, I trust, defy all the insidious workings of time with all the power that either talent can produce or ingenuity afford; but it is to the labours of Snellius, Newton, Faraday, and other great workers in the scientific world, that I am chiefly indebted." We ask our readers if this is not without a parallel in scientific literature?

In conclusion, there is internal evidence in "More Light" and "What is Matter?" to show that the author is a very young man. He has read much, and is by no means devoid of enthusiasm and a certain kind of cleverness. He is, however, unfortunately utterly devoid of modesty, and will, therefore, not accept advice. If he would, he might even now, perhaps, become a useful labourer in the field of science. Let him, instead of making a childish boast of never having made a single experiment, let him, we say, take up a physical or chemical question and experiment upon it earnestly and faithfully, and his mind will become disciplined, and, possibly, in his maturer years he may even acquire modesty. If he wishes to learn a great truth, let him experiment upon a subject which he has made all his own. Let him take pure water and see if, by passing the sun's rays through it, he can condense the chloride of sodium; if so, it is evident that, by the aid of "more light," he will obtain sea water. When he has condensed enough salt to be detectable by the spectroscope we will revise our review, retract our strictures, and unreservedly follow the Inner Templar as our guide, philosopher, and friend!

Revue Scientifique et Industrielle. Par EMILE KOPP, Professeur du Musée Royal et Industriel Italien à Turin. Extraits du *Courrier du Bas-Rhin.* Strasbourg: 1869.

IN this work—in which, (as somebody says) there is a thin rivulet of text meandering through a broad meadow of margin—we find nine articles, three of which, on "*Le Blanchissage Domestique*" we cordially recommend to the notice of housewives in general, and of all foreign nations—especially Sicily—in particular. Why M. Kopp has given this prominence to the subject we are at a loss to imagine unless he has fond recollections of *Blanchisseuses de fin*, and *Closerie de Lilas.* At all events, he has done good service, and shown an utter absence of pride by descending from the lofty heights of organic chemistry to the washing of linen; and what an astonishingly practical man he is! He t
"*Inconvenients d'un trop riche Assortiment de L*
it must be confessed, few have discovered;

[English Editio

savonnage, rinçage, azurage, tordage, and *sécharge.* We have found a frequent appeal to the dictionary necessary, and sometimes useless; let any of our readers tell us off-hand the English of *essangeage*: we had not the least idea that the French language was so rich in ablutory words, and we accept it as a happy omen. M. Kopp *must* become the hero of laundresses from his admirable ideas of economy; look here, for instance—"A la vérité le savon bien sec, surtout le bon savon de Marseille, se dissout bien moins rapidement, et on realise ainsi une économie notable." Will some *bon savant* tell us all about "le bon savon de Marseille?"

The other articles treat of the "Anomalous Properties of Water," of "Meteorites," of "Explosive and Fulminating Substances," of "Fire-Arms," of "Nitroglycerine," and of "Gun Cotton." They contain, for the most part, a good *resumé* of recent research in connection with each subject, and may be perused with advantage.

Exeter Change, for the British Lions. Edited by SNUG THE JOINER. London: B. Pardon and Son, Paternoster Row. 1869.

THE British Association for the Advancement of Science meets this year, as all the world knows, at Exeter. Exeter Change, as all the world—specially the younger portion of it—does *not* know, was once one of the sights of London; for therein were housed the British Lions which had whilom dwelt in the Tower of London, and symbolising the sovereignty of this realm, had been considered necessary appurtenances of Royalty. "Exeter Change," says the editor of the pamphlet before us, "has disappeared, and the ground hallowed by memories of the caged lions; and the solitary beadle is now occupied by the Gaiety Theatre. Need I add that my title-page is deeply significant. You British Lions have now an Exeter Change productive of gaiety."

"Exeter Change" is not a satire; it has nothing of the lampoon about it; the sarcastic Roman Pasquino would scarcely allow it to be called a pasquinade; there is nothing in it the least bitter or spiteful, nothing that smacks of the *Tomahawk*, or *Queen's Messenger*. The mention of an individual is generally accompanied by his laudation, or, if the reverse, the censure is no more than the most harmless "chaff." What, then, shall we call it? A parody? Scarcely. A squib? By no means. A burlesque? This is nearer the mark; particularly if we may trace the word through the Italian *burlesco*, and the Low Latin *burleschus*, to the classical *burya*, as Mr. Donald tells us; but Ainsworth is silent about *burra*, and approaches it no more nearly than *bura*, which signifies "the hinder part of a plough," and is scarcely appropriate. What, then, remains to us? A travesty? That will do better. "Exeter Change" is a sort of travesty; or, if the reader pleases, he may find in it just a *soupçon* of several of the above forms of composition.

Having defined our work, let us look more closely into it. In the "Prologue," the editor greets the various presidents of sections and learned bodies of the British Association, and states the object and aim of his work. This is followed by a "History of the Association," written in the exact and somewhat prosaic style of certain students of the Buckle School. Then comes the "Wail of the Mathematician," a poem in imitation of "Locksley Hall," which is clever, and shall speak for itself—albeit in a somewhat *staccato* manner. The mathematician here describes the progress of his courtship:—

"Once about the beach we wandered, spooning in a way sublime,
While the dreary tales of Science were reserved for future time;

When geologists before us on contorted strata prosed,
We were sure to find a seaweed in a place not much exposed."

[illegible] the Darwinian standard raised;
[illegible]ter got herself unduly praised;

[illegible]d with prelates grave;
Kitty's slave."

Determining to discard this fickle Kitty, the mathematician tries to find some strong-minded woman—

"Iron-visaged, tall, and skinny, she the bluest of the blues,
Shall with potent mathematics my domestic life suffuse.

Dingy black shall be her costume: pins shall take the place of hooks:
And her hair, close-cropped, shall startle followers of fashion books."

The poem is followed by a long article on "The Development Hypothesis," a travesty of some recent animadversions of the German anti-Darwinites. "On some Recent Spectral Observations" follows this. Herein a man is supposed to fall asleep in his library, and to see a vision of the various authors of the books around him, and to hold a short conversation with them: the following extract is taken from the concluding portions:—

"But there now arose such a clamour that I could not hear myself speak. Albertus Magnus *would* keep striking Avicenna with a crozier; Cardinal Bellarmine threw his hat at Galileo; Abelard tripped up William of Champeaux, the pretty little Heloise flirted with Peter of Cluny; while a host of Plenists, headed by Father Linus, were having a set fight with a host of Vacuists, headed by Robert Boyle."

Next we have "Mercurius Rex"—a chemical ode. Recitative and air, with accompaniments of Maëlzel's metronome, contrabassos in F in altissimo, Helmholtz's double syren, and the tibia pastorale.

In the next article—"On the Alcoholic Compound termed Punch," by John T—nd—ll, LL.D., F.R.S.—we have a capital imitation of the style of a certain eminent lecturer and physicist. Let us content ourselves with the last two paragraphs—

"Experiment has proved that the juice of three or four lemons, and three-quarters of a pound of loaf sugar dissolved in about three pints of boiling water, give saporous waves which strike the palate at such intervals that the thrilling acidity of the lemon-juice and the cloying sweetness of the sugar are no longer distinguishable. We have, in fact, a harmony of saporific notes. The pitch, however, is too low, and to heighten it, we infuse in the boiling water the fragrant yellow rind of one lemon. Here we might pause, if the soul of man craved no higher result than lemonade. But to obtain the culminating saporosity of punch, we must dash into the bowl, at least, a pint of rum and nearly the same volume of brandy. The molecules of alcohol, sugar, and citric acid collide, and an entirely new series of vibrations are produced—tremors to which the dullest palate is attuned.

"In Punch, then, we have rhythm within rhythm, and all that philosophy can do is to take kindly to its subtle harmonies. It will depend in some measure upon previous habits, whether the punch when mixed will be taken in excess or in moderation. It may become a dangerous ally of gravity and bring a sentient being to the gutter. But, on the other hand, it may become the potent inner stimulus of a noble outward life."

The remainder of the pamphlet is filled with shorter articles:—An "Alphabet for Young Associates;" "Rejected Addresses," giving a list of certain supposititious papers rejected by different Sections;" Advice "To the Dyspeptic Members of the Association," containing a *menu* in which we notice "Goujon sauté en l'eau froide;" "Poulet pansu;" "Porc à la trichine;" "Xéres de Hamburg nouveau et brûlant;" and "Vin d'Oporto des environs de Spitalfields."

"Eozöon Canadense: a lay of Chivalry from Section C" is a poem of twenty-one stanzas; "What will they do with it?" an account of a meeting in the Albert Hall of Arts and Sciences" in 1872, when a grand difficulty has arisen as to what use the Hall shall be applied to, and various *savants* express their various opinions. Then we have a letter from Francis Bacon, headed "Elysian Fields, August 15th, 69," in which, in the quaint English of the early part the seventeenth century, Bacon refers to his treatise Nova Atlantis," and shows that he therein shadowed forth such an Association of the learned as we now have in the British Association for the Advancement of Science.

Altogether, "Exeter Change" is very readable. There is not much wit in it, but it is pleasant and lively, and never gross or coarse, nor do we detect any *doubles entendres*, too often the vehicle for raillery and sarcasm, and sometimes for what is worse. It is evidently the work of young writers; and it is equally evident that the matter has been struck off rapidly, without much elaboration, and this we consider an advantage, for, by the means, we get fresh, budding ideas, in the place of garish and dressed-up piracies. We wish Snug the Joiner, and his colleagues, Peter Quince and Nick Bottom, every success; and we commend their trim little work, not alone to members of the Association, but to their scientific *confréres* who have not journeyed to Exeter.

CORRESPONDENCE.

Royal Sulphur Spring, Harrogate.

To the Editor of the CHEMICAL NEWS.

SIR,—In my communication on the above spring, published in your valuable journal of the 16th of July (CHEMICAL NEWS, vol. xx., p. 26; *Am. Repr., Sept.*, 1869, *page* 140), by some mishap I omitted the analysis; it is appended:—

Saline Ingredients in the Imperial Gallon.

	Grains.
Carbonate of lime	18·649
Carbonate of magnesia	1·783
Carbonate of baryta	0·291
Carbonate of strontia	trace
Chloride of sodium	538·180
Chloride of potassium	3·103
Chloride of calcium	32·327
Chloride of magnesium	27·872
Chloride of barium	0·494
Chloride of strontium	trace
Chloride of lithium	faint trace
Sulphide of sodium	9·135
Iodides, bromides, &c.	traces
Total grains per gallon	631·834

—I am, &c.,

SHERIDAN MUSPRATT, M.D.

College of Chemistry, Liverpool,
July 26, 1869.

Oleographs.

To the Editor of the CHEMICAL NEWS.

SIR,—Having been from town, I have only to-day seen the CHEMICAL NEWS, and I beg you will allow me to reply briefly to Mr. Tomlinson's letter in reference to oleographs. Like every other new and valuable discovery, oleography is praised, and by others condemned. Oleography is yet in its infancy, and, just as a new and perfect process for the ultimate analysis of a complex organic substance cannot be devised in—it may be years, so we cannot expect perfection at once in this beautiful method for testing oils. I can assure Mr. Tomlinson that it is no fault of mine that he is pestered with numerous paragraphs from all varieties of journals commending oleography. I never sent any article to one of them but the CHEMICAL NEWS on the subject, nor have I seen them. My opinion is yet the same that oleography is, in its present and very much improved state, an excellent conjunctive test for the purity of oils. No one can doubt for a moment, who has really worked at the subject carefully, that an oil figure on water can be transferred in an instant, perfectly uninjured, to paper. In the examination of trade oils, besides using oleography to assist me, I also employ the following among other tests:—

Appearance, gravity, taste, odour, rate of passage through narrow tubes, weak and strong solutions of potassic, sodic, and ammonic hydrates; shaking the oil, rise in temperature with hydric sulphate, boiling in alcohol, boiling point, burning in lamp, freezing point, passing chlorine, calcic hydrate, euchlorine, calcic hypochlorite, mercurous nitrate, hydric phosphate.

I trust Mr. Tomlinson is satisfied that I have no desire to associate his name with oleography further than to acknowledge that his name is intimately connected with cohesion figures. At many lectures I have given, here and elsewhere, in which I introduced oleography, I always took care to mention Mr. Tomlinson's name while referring to cohesion figures only. I perfectly agree with him in not wishing to describe oleography as having arrived at perfection. It is quite a young art yet; it has fulfilled all I have said, and it promises greater things.—I am, &c.,

R. Carter Moffat.

Laboratory, Glasgow Mechanics' Institution,
August, 4th, 1869.

MISCELLANEOUS.

Hallogenin.—Under this name is sold in Germany a mixture of salts intended to prevent the formation of incrustations in steam-boilers. The mixture consists of 65 per cent of sal-ammoniac, 17 per cent of chloride of barium, and 18 per cent of catechu; it is said to answer its purpose very well.—*Deutsche Ind. Zeitung.*

Removal of Nitrate of Silver Stains from Woven Tissues.—According to M. Grimm, chloride of copper completely removes, even from coloured woven cotton tissues, stains occasioned by nitrate of silver; the tissue is to be afterwards washed with a solution of hyposulphite of soda, and next thoroughly washed with water. From white cotton and linen tissues, nitrate of silver stains are more readily and effectively removed by applying dilute solutions of permanganate of potassa and hydrochloric acid, followed by washing with hyposulphite of soda solution, and rinsing in plenty of fresh water. By these means the use of the highly poisonous cyanide of potassium is rendered unnecessary.—*Polyt. Notizblatt.*

Protection of Wood from Fire.—We learn from the *Deutsche Industrie Zeitung* of July 1, that at one of the collieries at Ibbenbüren, Westphalia, the woodwork is protected from fire by being painted with a mixture consisting of 5 parts of alum, 7 parts of rye-meal paste, and 30 parts of previously washed, *i.e.*, finely divided, clay (this mixture is used for woodwork not exposed to open air); for woodwork, so exposed, a mixture is used consisting of 2½ parts of crystallised sal-ammoniac, 1 part of white vitriol (commercial sulphate of zinc), 2 parts of joiners' glue, 20 parts of zinc-white, and 30 parts of water. These mixtures have been found to prevent wood bursting into flame on ignition, and to greatly delay its destruction even when severe fires are raging.

Thermoscope for Lecture Rooms.—Dr. A. W. Hofmann states that he frequently makes use of the following arrangement for the purpose of exhibiting, in a ready manner, the evolution of heat which takes place in chemical combinations and decompositions.—Some ether is poured into a tall test tube, and this tube is placed, for instance, in a recently-made mixture of sulphuric acid and water, the ether begins to boil, and its vapour may be ignited; in order to regulate the boiling of the ether it is best to place in it a platinum wire spiral. When, in a beaker glass, some sulphuric acid is first poured, and next, carefully on the top thereof, a layer of water, and these fluids are suddenly mixed by stirring the same with the ether tube, a flame of half a metre length may be suddenly evolved from the tube. The author has frequently applied this [illegible] exhibit the disengagement of heat on [illegible] saturated solution of acetate of soda.—*Berichte der Deutsche Chem. Ges. zu Berlin.*

[This device was frequently adopted by Faraday during his Christmas Lectures.—*Ed.* C.N.]

Application of Leichtenberg's Experiment to the Mineralogical Analysis of Rocks.—M. S. Meunier proposes to make use of the well-known experiment of Leichtenberg's electric figures to separate from each other the divers mineralogical constituents of some kinds of rock. We briefly remind our readers that the experiment alluded to consists in charging with electricity a cake of resin or sealing-wax, by means of a previously-charged Leyden jar; it is thus possible to charge certain portions of the cake with positive, others with negative, electricity. In order to exhibit this to sight it is usual to blow, by means of a small pair of bellows, on to the cake of resin, a mixture of very finely-powdered red lead and sulphur; the friction, on leaving the nozzle, causes the powders to become electrified, and the sulphur being negatively electric is attracted by the curved figures positively electric on the cake, while the red lead follows the opposite course. M. Meunier has tried thus to separate sulphur-bearing trachite into its mineral constituents, and succeeded perfectly in getting the sulphide and feldspar from each other; he states that he has equally well succeeded with rocks made up of two different silicates.—*Cosmos.*

Analysis of Polcura.—Under the name of polcura there has been lately brought from St. Jago de Chili a mineral, met with, at a height of from 12,000 to 14,000 feet above sea level, in the Cordilleras de los Andes, imbedded between porphyry and melaphyr; this mineral exhibits a dirty yellow-coloured grainy somewhat crystalline mass; is acid and astringent to the taste; heated to 120° C., it loses 13·560 per cent. of water, 24·184 per cent. of the substance is soluble in boiling water from the portion insoluble in that fluid, equal to 62·251 per cent., hydrochloric acid dissolves 12·351 per cent., while the remaining 49·900 per cent. is silica. The portion soluble in water yielded, on being quantitatively analysed, results as follows:—Sulphate of potassa, 2·5 per cent.; sulphate of soda, 2·7; sulphate of lime, 26·1; sulphate of magnesia, 16·1; sulphate of alumina, 40·2; persulphate of iron, 4·6; chloride of sodium, 0·4; and soluble silica, 7·4. The portion insoluble in water, 62·251 per cent., consists of the following substances:—Alumina, 2·007; peroxide of iron and trace of manganese, 6·700; sulphuric acid, 3·330; silica, 49·900; and water. 13·560. The polcura is applied, in the country where it is found, to the tawing of the skins of sheep, goats, and calves; from the composition of its constituents, soluble in water, it will be readily seen that it is eminently fit to serve this purpose.—*Dingl. Polyt. Journ.*

Bubbles of Mercury floating on Water.—When the lecture room of a chemical laboratory is provided with a sufficient supply of water under strong pressure, it is possible to make, and exhibit there, an experiment which, owing to a deficient pressure of water in such rooms, has been almost unnoticed. The experiment is the following:—Under an ordinary water-tap, the opening of which has from 10 to 12 m.m. diameter, a large-sized porcelain basin is placed, containing from 15 to 20 kilos. of mercury; the water-tap being suddenly opened, a strong flow of water is caused to fall into the basin at a height of from 8 to 10 centimetres from its bottom. On turning off the flow of water again, it will be seen that on the surface of that fluid there float about bubbles of mercury, usually exhibiting a diameter of only 1 centimetre, but occasionally some are found of two or three times that size. As a rule these bubbles are very ephemeral; now and then, however, it happens that some may be caught, along with a quantity of water, in a small beaker glass, and, on the mercurial bubbles bursting, it will be seen how very small a quantity of mercury these bubbles consist of. Professor Hofmann mentions that he saw this experiment first exhibited in the lecture room of the Royal College of Chemistry, London, when, some twenty years ago, Professor Melsens, rom Bruxelles, was on a visit there. The pressure of water

at the lecture room just named is from 10 to 12 metres; in the new laboratory of Berlin University the pressure of the water circulating in the tubes and pipes is from 20 to 25 metres.

University of London.—The following are lists of the candidates who have passed the recent examination in Arts and Science. *First B.Sc. Examination (Pass Examination).*—First Division. Edward Bibbins Aveling, University College; Walter W. Rouse Ball (First B.A.), University College; Henry Septimus Bott, Owens College; Frank Clowes, Royal College of Chemistry and Pr. st.; John William Elwes, King's College; Thomas Oliver Harding, B.A., University College; Marcus Manuel Hartog, University College; Charles William Hodson, Chester College; David Bridge Lees, B.A. Camb., Owens and Trinity College, Cambridge; Robert Routledge, Owens College. Second Division. Hampden Gurney Jameson, University College; Sidney Follett Osler, University College; Charles Rigg, Chester College; Robert Davies Roberts, University College.

The Metric System of Weights and Measures.—The second report of the Standards Commission has just been published, together with an appendix of detailed information. The Commissioners confine themselves in this report to the questions connected with the metric system, and with its adoption in the United Kingdom; and they consider the reasons for and against its introduction under two heads—namely, those which relate to the internal commercial transactions of the country; and those which relate to transactions with other countries. With regard to the former, they observe that there is at present no inconvenience arising from the discordance between the customary weights and measures, because, whatever difference may prevail as to the multiples in local use, the essential units—the yard, the pound, and the gallon—are everywhere the same; based upon standards which are constructed with the utmost skill and care, and supported by a system of inspection which, though chargeable with imperfections, is, on the whole, efficient. Moreover, the requirements of different trades need somewhat different bases. The yard is a very convenient length for draper's measures, but the foot is far more convenient for carpenter's measure. It has been remarked that the last, or coomb, the bushel, and the peck, are well suited for men's backs, arms, and hands; and also that the natural inclination of the mind to halve and quarter continually exhibits itself in the subdivision of almost every base. The metric system does not offer facilities either for the change of the adopted base, or for the continued binary subdivision; and any attempt to force it into use in shops and into workmen's operations and accounts would probably be felt as a needless grievance. At the same time the want of weights and measures, on a decimal scale generally, or on the metric scale specifically, is not unfrequently felt by the manufacturing and trading classes, and more especially by men of science and by chemists and engineers of the highest class; and it appears hardly possible to satisfy this want except by the legal establishment of metric standards, and by the legal sanction of the use of metric weights and measures in shops and offices of conveyance. In order to prevent confusion, it would be necessary to provide that the metric weights and measures should have such form or other characteristics as would render it impossible to mistake them for those of the existing system; and in a future report the Commissioners promise to deal with the question of further simplification by the abolition of troy weight. Passing on to our transactions with foreign countries, the Commissioners remark upon the recent great increase in the amount of these transactions, and argue from it to the permissive adoption of the system which agrees with that of so many of our foreign trade correspondents, as well as to the giving the ordinary statistical publications relating to trade on the metric as well as on the imperial system. Attention is next called to the degree in which the introduction of a decimal system of coinage would assist in rendering the public familiar with the use of decimal weights and measures; and the report concludes by recommendations arranged under nine heads. These recommendations are, in substance, that metric standards under the French nomenclature should be legalised and provided, but that the use of the system should be entirely permissive, and not even in prospect compulsory; that regulations should be adopted to prevent confusion between the two classes of weights and measures; that Customs and other duties might be levied and the business of public departments conducted by either system; that mural standards of both systems should be exhibited in public places; and that the decimalisation of our system of coinage should be undertaken by the Government. At the same time it appears to the Commissioners to be essential that any measure for the introduction of the metric system should be proposed to Parliament by the Executive Government; and, considering that the Commission will shortly enter upon the questions referred to, those relating to the system of local inspection of weights and measures throughout the United Kingdom, its members are of opinion that "it is expedient that no legislation should take place with respect to the metric system until the whole subject of the weights and measures of this kingdom be brought before Parliament in one bill."

To Melt Two Metallic Mixtures by Friction.—Melt, in one vessel, one part of mercury and two parts of bismuth; and in another one part of mercury and four of lead. When cold, they will be quite solid, but, by rubbing them against each other, they will soon melt, as if each had been rubbed separately against red-hot iron.—*American Artisan.*

Death of M. Leiber.—We regret to learn the sudden demise of M. Leiber, the founder of the *Moniteur de la Photographie*, and the *Encyclopédie Photographique*, one of the kindest and most intelligent of the scientific publishers of Paris. His establishment, the Librairie Centrale des Sciences, in the Rue de Seine, has, for the last fifteen or twenty years, been the daily resort of the most eminent men of science; and his extensive knowledge of the older chemical and physical opuscules (memoirs, papers, notes, reprints, &c.) published in France, Germany, England, and America, caused him to be frequently consulted by literary men and authors of scientific works. His loss will be keenly felt by a very large portion of the enlightened Parisian public. Among the foreign works issued by him in French, we may notice the excellent little treatise on "Electricity," by Sir William Snow Harris, and De Filippi's charming "Letters to my Daughter on Terrestrial Creation."

Molybdenum and Chromium.—These metals can, according to Loughlin, be easily prepared as follows:—A mixture of one part of pure molybdic acid and one and a half of cyanide of potassium is placed in a porcelain crucible, and the lid luted on; this is placed in a large crucible, and the interstices having been packed with animal charcoal, the entire arrangement is exposed to a strong white heat for twelve hours; when cold the inner crucible is found lined with a white silver-like metal not acted upon by hydrochloric acid, but readily dissolved by nitric acid, and having a specific gravity of 8·56. By substituting oxide of chromium for molybdic acid metallic chromium is obtained.—*Engineer.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional*

advantage of keeping the readers on a level with the latest advances of science.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Manufacture of Chocolate.—M. Tresca.—Although this matter appears very heterogeneous, and even trivial, we must not neglect to say a few words on this subject, taken from the ably-written report made by the gentleman just named, on the chocolate mills and factory belonging to M. Mênier, situated at Noisiel. The proprietor, well known by name, also, in this country, is the owner, also, of a large estate in Central America, entirely devoted to the cultivation of the cacao tree (*Theobroma cacao*), from which the nuts are obtained which serve for the manufacture of an article of diet which contains every element required for the due nourishment of the body. The factory at Noisiel employs 300 workpeople, and during the last ten months the quantity of chocolate made has amounted to 2,388,347 kilos. (fully 2388 tons); the quantity of tin-foil used for packing amounts to a value of 10,000 francs a month; and the duty paid by M. Mênier alone to the French *donane* amounts, for cacao alone, to a sum of nearly one and a half millions of francs yearly, exclusive of the sugar duties. M. Tresca states that the article is prepared with great care as regards the production of a really first-class and genuine material.

Cosmos, July 24, 1869.

Native Copper in Belgium.—While some drainage works were being executed at Vielsalm, province of Liège, the workmen found, at no great depth under the surface, a piece of native copper weighing about 2 kilos., and partly hollow inside, exhibiting crystals. This discovery has led to further research, the result of which is the finding of some veins of malachite.

Meteoric Appearance.—M. E. Arnoult, the well-known editor of *l'Institut*, writes from Vendôme, Département de Loir et Cher, about 80 miles south-west of Paris, stating that on the 15th of July, at 8.45 p.m., there was seen there a very bright meteor, which moved slowly from east to north, at an angle of about 45° above the horizon; it emitted a yellowish white light, so strong as entirely to overpower the light of the moon in her first quarter; it disappeared, without any perceptible noise or sound, in a few seconds, giving off a large number of very brilliant sparks. Since the writer of this brief communication is a good and trustworthy observer, and since he learned afterwards that several other parties had recognised this meteor at about the same time, there can be no doubt about the fact that a peculiar appearance had been observed.

Geological Map.—We learn from this periodical that a very greatly improved and enlarged geological map of Central Europe has been prepared and edited by the well-known geologist, *emeritus* Director-General of Mines for Prussia, M. von Dechen. This new map is on a scale of 2,500,000ths, and embraces the whole of Germany, France, England, and adjacent countries. The same author has recently finished a large geological map, in 32 large sheets, of Rhenish Prussia and Westphalia, which may be considered as one of the best ever executed of the kind, and one of the finest specimens of chromo-lithography ever published. The price of these works being very moderate, will ensure them a largely-extended sale.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 10, June 12, 1869.

This is a double number of this periodical, containing, in the first place, a very interesting and lengthy account of a *soirée* given by the president of the Society, on the 15th of May last, at the chemical laboratory of Berlin University. Following the plan of the printed periodical, we quote, in the first place, the catalogue of the brilliant exhibition of objects of interest to the scientific party assembled; this catalogue is divided into three sections, comprising:—A. Exhibition of Chemical Preparations of High Scientific Interest.—(1) M. Baeyer, Berlin, "Preparations of Indol, honystone, preparations of mellithic acid;" (2) M. Darmstädter, Berlin, "Chlormethyl-isaethionate of sodium;" (3) M. H. Wichelhaus, Berlin, "β-binitronaphthalin and derivatives of naphthol;" (4) M. Frank, Stassfurt, "Collection of bromates and other bromine compounds;" (5) M. Gräbe, Berlin, "Compounds of chinon and artificial alizarine;" (6) M. Ladenburg, Heidelberg, "Preparations of silicium;" (7) M. Leibreich, Berlin, "Protagon, neurin, oxyneurin, and salts thereof;" (8) M. Martius, Berlin, "Victoria yellow, and compounds of binitro-kresol;" (9) M. Oppenheim, Berlin, "Mentha-camphor and derivatives of propylen;" (10) M. Scheibler, Berlin, "Collection of divers kinds of sugar, and models of the crystalline form some of these exhibit;" (11) M. Wichelhaus, Berlin, "Bibromo-pyroracémic acid and naphthol." B. Exhibition of Drugs, and of Products of Chemical Works.—This catalogue is by far too lengthy for reproduction; moreover, a great many of the substances exhibited are, if not better, at least equally well manufactured in this country; we notice, however, the following rare substances manufactured on the large scale: M. E. Jacobsen, Berlin, "Peroxide of hydrogen, made by a new and peculiar process." Among the extensive series of substances exhibited by MM. Lampe, Kaufmann, and Co., Berlin, we notice a collection of thirty different preparations of quinine; *ferrum dialysotum;* pure pepsin; a large collection of chemically pure essential oils, among which *oleum cajeputi, oleum calami, oleum neroli*, and a large number of others; a fine collection of rare kinds of opium, among these some of German cultivation. Dr. Marquart, Bonn, the owner of very extensive and eminently well-conducted chemical works, exhibited large quantities of ethyl-benzol, zinc-methyl (chemically pure), zinc-ethyl, ethyl-methylaniline, anhydrous sulphuric acid, anhydrous phosphoric acid, hydrochlorate of ethylamine, chloride of carbon, several distinct compounds of chlorine and phosphorus, aldehyde, carbonic acid ether, oxide of mesityl, and a number of similar rare compounds, all perfectly pure and fit for scientific research. M. Schering, operative chemist, Berlin, exhibited a group of crystals of re-sublimed iodine, 2 feet in diameter; several rare compounds of bromine with metals; chemically pure tannic and gallic acids; rare preparations of cadmium and mercury. C. Exhibition of Physical and Chemical Apparatus and Glass and Porcelain Ware.—This portion of the exhibition surpassed even the two former, not only for extent, but also for the exquisite novelty and finish and utility of the apparatus exhibited; we can only quote a couple out of the very many:—M. Elster, manufacturer of gas-meters, Berlin, exhibited a highly-sensitive photometer, and experimented with it during the evening in one of the rooms of the laboratory. M. Geissler, Berlin, exhibited his large mercurial air-pump, and showed experiments with it in the laboratory set apart for gas analysis.

We abstract the following from the speech of the President of the Society, Dr. A. W. Hofmann. After having welcomed his scientific guests, the Doctor first alluded to the fact that the laboratory wherein they met had not been opened in a more official manner, and a meeting held therein honoured by the presence of high and mighty officials and rulers of the empire; but, he said, it was far more agreeable to him to see assembled together, on the evening of the day upon which the finishing touch had been laid by the workpeople to this temple of science, men who would appreciate with him the importance of this achievement for the University of Berlin specially, and for the scientific world in general. The eminent speaker then entered into the history of the causes which so long delayed the building of really good laboratories at Berlin and Bonn, long after the four* other ancient universities of the Prussian empire, as it existed before the late

* Prussia Proper has Universities at Breslau, Königsberg, Greifswald, Halle, Bonn, and Berlin; and in addition, the universities of Göttingen, Marburg, formerly belonging to the Kingdom of Hanover and the Duchy of Hesse Cassel, are now Prussian Universities.

conquests, had been amply provided with laboratories which were worthy of the advance of chemical science of the present day. The building of the Berlin laboratory, just finished though it has been in partial use for one year, occupies a space of 21·680 sq. ft. The building, of which, with the present number of the above-quoted periodical, three lithographic prints are given, exhibiting, respectively, its frontage and the plans of the ground-floor and first-floor, has cost 318,000 thalers (£47,700), which sum the Prussian Government has granted for the purpose. The speaker next commenced a lecture on divers scientific subjects, from which we quote the following:—

Increase of Weight During Combustion.—The main feature of this brief *exposé* is the description of an experiment. A small horse-shoe magnet is hung up at the beam of a balance sufficiently sensitive to turn with centigrammes; the poles of the magnet are immersed for a moment in the *limatura ferri* of the chemists' shops, and a beard of small particles of iron is caused to adhere to the poles; by means of proper weights placed on the scale-pan at the other end of the beam the equilibrium is restored. This having been done, the finely-divided iron is kindled, by approaching to it the flame of a Bunsen gas-burner, and continues to burn. While burning, it will be seen that the arm of the balance on which the magnet is suspended considerably deviates from the horizontal position, thus indicating an increase of weight on the side where the experiment is going on. This experiment succeeds best with a magnet of moderate dimensions; the horse-shoe magnet applied in this instance weighed, without its armature, 210 grms., and can bear a load of 12·5 grms. of iron; when this is altogether converted in magnetic oxide, by combustion, the increase in weight will be about 4·7 grms.

Formation of Ferric Acid.—An intimate mixture is made of one part of *ferrum limatum*, and two parts of nitrate of potassa. The speaker said he took, of both together, usually from 20 to 30 grms.; these are heated in a small glass flask over a strong gas flame; the mixture soon becomes quite incandescent, emits, out of the mouth of the flask, a firework of sparks, and leaves, at last, a mass partly fused together with the glass of the flask, consisting of ferrate of potassium. After cooling, this mass is reduced to powder, and, being exhausted with water, yields a deep reddish violet coloured, nearly transparent solution. Unless great care be taken to let the mass become quite cold before any water is added, the operation is spoiled.

We regret we can only quote the titles of the following subjects, briefly alluded to by the eminent lecturer, on account of the impossibility of properly giving any condensed review without reproducing the woodcuts annexed to the originals:—

Volumetrical Analysis of Hydrochloric Acid and Ammonia by means of Electrolysis.

Condensation of Hydrogen and Oxygen when forming Water-Gas (vapour of water at very high temperature).

Lecture-Room Analysis of Marsh Gas and Olefiant Gas.

Lecture-Room Eudiometer.

Equality of Volume of Oxygen, and of the Carbonic Acid and Sulphurous Acid obtained from it.

Oxidation of Ammonia.

Evolution of Oxygen from Nitric and Sulphuric Acids.

Experiments on Flame.

Lecture-Room Thermoscope.

Comparison of the Volume of Different Gases submitted to the same Changes of Temperature and Pressure.

Compression of Gases by means of the Pressure exercised by a Column of Mercury.

Liquefied Sulphurous Acid Gas.

Bubbles of Mercury Floating on Water.

Local Ventilation as Lecture-Room Experiment.—This last paper contains a brief *resumé* of the excellent mode of ventilation adopted in the lecture-room of the Berlin laboratory.

On the 24th of May last the Society held one of its ordinary meetings, at which the following papers were read and communications made:—

Behaviour of the Trichlorinated Acetic Acid Salts and of Chloral with the Animal Organism.—M. Liebreich.—This physiologico-chemical paper is partly an answer to the question the author put to himself—Whether, during the splitting-up of such chemicals, of which the physiological effects of the bodies they separately yield on being split up is well known, the splitting-up thereof in the animal organism itself brings on the same phenomena as if the component substances were individually administered to an animal? As far as the author's experiments go, they seem to prove that the splitting-up of substances as those experimented with and named in the heading to this paragraph, actually produce phenomena, from which it is just to infer that they are produced by products derived from the splitting-up of the substances experimented with.

Action of Sulphide of Carbon upon Oxamide and Acetamide.— M. Ladenburg.—The decomposition of oxamide sets in at 180°, and is not quite finished at 200°. In order to avoid explosions, the sealed tubes have to be opened after several hours' exposure to heat. Among the gases which escape on opening the tubes, oxysulphide of carbon is the chief, mixed, however, with some oxide of carbon and hydrosulphuric acid. The reaction may be represented by the following formula:— $C_2O_2N_2H_4 + CS_2 = CSNH.NH_3 + COS + CO$. As to the reaction of acetamide and sulphide of carbon, the author states—"I have never been able to get it satisfactorily ended; it begins below 200°, at 210° a strong disengagement of gas takes place, and at a higher temperature the tubes always exploded. The disengaged gases contain much H_2S, COS, and CO, also vapours of hydrocyanic acid, and combustible gases not absorbable by baryta-water and protochloride of copper. In the residue in the tube, only sulphocyanide of ammonium and acetamide were left.

Formulæ of Benzol.—M. Ladenburg.—It is impossible to give a proper abstract of this paper without reproducing the woodcuts representing certain mathematical figures essentially belonging to this paper.

Contribution to the History of the Salicyl Compounds.—M. Henry.—After referring to a series of experiments made by the author with the view of exhibiting the action of pentachloride of phosphorus upon salicylic aldehyde, the author now communicates the results of his researches on the action of pentabromide of phosphorus upon salicylic aldehyde. This action, he says, although less violent than that of the pentachloride of phosphorus, is yet rather strong. On purifying, first with water, and afterwards with ether, the substance resulting from this reaction, he obtained monobromated salicylic aldehyde—

$$C_6H_3Br \begin{cases} OH \\ CHO. \end{cases}$$

When two equivalents of pentabromide of phosphorus were made to act upon one equivalent of salicylic acid, a substance was obtained which, after having been purified by means of ether and alcohol, exhibited a crystalline appearance, fusing at about 165°, and subliming at between 150° and 155°; formula—

$$C_6H_3Br \begin{cases} HO \\ COHO. \end{cases}$$

Salicylic acid metyl-ether is not acted upon in the cold by pentabromide of phosphorus, but, on heating, among a series of secondary products, a substance is obtained named monobromo-salicylic acid ether—

$$C_6H_3BrCO\overset{HO}{(CH_3)}O.$$

It is a solid, fusing at between 36° and 38°, and boiling at about 266°; its alcoholic solution is coloured beautifully

violet on addition of a few drops of an alcoholic solution of perchloride of iron.

Researches on some Ethereal Derivatives of Polyatomic Acids and Alcohols. — M. Henry.— Unless we were to fill about a column of our pages with formulæ only, the condensed reproduction of this paper would neither do credit to its author nor be of use to our readers; we therefore only quote the title.

Contribution to the Chemical History of Diallyl.—M. Henry.—This is a preliminary notice on diallyl, C_6H_{10}, from which we learn that diallyl readily combines with N_2O_4, yielding a solid mass of white crystals composed according to the formula $C_6H_{10}(NO_2)_4$. Diallyl also combines with hypochlorous acid, yielding a fluid heavier than water, formula—

$$C_6H_{10}\begin{cases}(OH)_2\\Cl_2\end{cases}$$

On the Stilben Series. — M. Grimaux. — This paper, owing to the large number of formulæ necessarily belonging to it, is not well suited for abstraction.

Annalen der Physik und Chemie, von Poggendorff, No. 5. June 15, 1869.

This periodical contains the following original papers:—

Definition of the Course of the Boomerang.—Dr. E. O. Erdmann. — A purely mathematico-mechanical essay.

Researches on the Behaviour of Vapours as regards the Law of Mariotte. — Dr. H. Herwig. — A lengthy physico-mathematical monograph on this subject, not suited for abstraction.

Nature of the Liquids found Enclosed in certain Minerals.—MM. Vogelsang and Geissler.—The authors review, in this paper, first, the labours of Davy, Simmler, Brewster, and others on this subject, and next state that they have applied for their researches spectrum analysis and microscopic research. Without a reproduction of the engravings accompanying this paper, it would be impossible to make the apparatus, and the mode of action thereof, understood. It appears as chief result of the researches made by these authors, that liquefied carbonic acid and water are very commonly met with enclosed in various minerals.

Researches on the conditions Influencing the Evolution of Bubbles of Gas and Vapour, and on the Forces which thereby come into Play.—M. H. Schröder.—This paper is the first instalment of a lengthy essay on a rather intricate subject. Since the author intimates that he will give a condensed *resumé* of the main results of his researches at the end of his essay, we prefer not to go into particulars just now.

Reduction of Accurately-Made Weights, and Determination of the Error of Absolute and Relative Weighing Without Reduction. — Dr. K. L. Bauer.

Construction of Galvanoscopes which are Extremely Sensitive.—M. H. Weber.—These are purely mathematical papers.

Form and Constitution of the Puddling-Dross Crystals obtained at the Steel-Works, Hombourg-Haut, near St. Avold, Departement de la Moselle.—M. Kosman.—After reviewing the labors of others on this subject, the author first enters into a lengthy and purely crystallographical description of the crystals alluded to in the title. The specific gravity of this material is 4·44. the colour of the powder bluish green. In 100 parts, the substance contains:—Metallic iron, 0·29; monosulphuret of iron, 1·43; phosphuret of iron, 3·31; peroxide of iron and sesquioxide of manganese, 5·99; Fe_2O_3, 4·79; protoxide of manganese,* 0·75; lime,* 1·16; phosphoric acid,* 1·48; silica, 24·04; protoxide of iron, 47·50; protoxide of manganese, 7·35; lime, 0·82; magnesia, 1·49.

* The analyst considers that these three, equal to 3·39 per cent, are combined together according to the formula—
$(3MnO,PO_5)+2(3CaO,PO_5)$.

Determination of Galvanic Resistance.—M. J. Sirks.—A mathematical paper.

Spectrum of the Aurora Borealis.—M. J. A. Angstrom.—This paper is taken from the author's work, highly spoken of by M. Poggendorff, "Researches sur le Spectre Solaire," 4to, Upsal, 1868, avec Atlas de Six planches. The light exhibited by the Aurora Borealis is almost monochromatic, and shows one single bright line to the left of well-known lines of the calcium group.

Fluorescent Liquids for Geissler's Tubes.—Dr. Seilhorst.—The researches of this author have brought to light the fact that a good deal of deception is practised by the makers of the tubes, who make inaccurate statements as to the nature of the fluids they contain. The author found that *tinctura rad. curcumæ* answers best for yellowish green, *tinctura sem. daturæ* for deep green, *tinctura guajaci* for deep blue, *tinctura ligni quassiæ* for bright blue, *tinctura corticis Æsculi* for bluish green, and petroleum for bright blue. The author could not obtain a red fluorescence; all the tinctures are alcoholic.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 198, June, 1869.

This periodical contains the following original papers:—

Report on the Chocolate Manufactory of M. Menier, at Noisiel (Seine et Marne).—MM. Tresca and Duchesne.—This report has been already alluded to by us, abstracted from another paper.

Report on a Peculiar Process of Dyeing a Fast Grey.—M. Barreswil.—The author states that MM. Bretonnière and Co., at Laval (Mayenne), have introduced very successfully the use of protonitrate of mercury as a mordant; and they apply, as dye, a solution of sulphuret of potassium, using 1 kilo. of that salt to 18 kilos. of woven tissue, or yarn, dissolving the salt, of course, in a sufficient quantity of water. The colour thus produced is essentially due to the formation of sulphuret of mercury on and in the tissues; and, according to the author of this paper, the colour is fast, that is to say, not destroyed by washing with soap or alkaline lyes, and resisting acids, but destroyed by chlorine.

Purifying of Syrups and Molasses by means of the Osmogene.—M. de. Luynes.—This paper describes the details of M. Dubrunfaut's method of refining coarse syrups and molasses, by an apparatus called osmogène; but, unless the engravings annexed to this paper were reproduced by us, it would be impossible to understand the description properly.

The remaining papers in this number are—The continuation of a lengthy paper on—

Electro-Magnetic and Magneto-Electric Apparatus for Medicinal Applications;

A continuation of a report—

On the Culture of Truffles;

And a paper relative to locomotive engines.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 4, July 26, 1869.

A very considerable portion of this number is again devoted to an apparently never-ending dispute about the Pascal, Newton, and Chasles-Le Verrier controversy. Among the papers we notice:

Researches on the Products of Oxidation of the Principal Normal Alcohols.—MM. Pierre and Puchot. —The authors have used the well-known plan of acting with bichromate of
subm

ducts of this reaction, between the normal acid belonging specially to an individual alcohol, its aldehyde, and the compound ether, which are proper to each separate alcohol; for instance, with amylic alcohol, valerianate of amyl may be obtained; with butylic alcohol, butyrate of butyl may be produced. The authors describe, at great length, what precautions are in general required to be observed in experiments of this kind, and then specify the following particulars:—(1) The preparation of valerianate of amyl, $C_{10}H_9O_2$, $C_{10}H_{10}O$, by the oxidation of amylic alcohol; (2) the preparation of butyrate of butyl, $C_8H_7O_2$,C_8H_9O; (3) the preparation of propionate of propyl, $C_6H_3O_2$,C_6H_7O. These preparations are concisely described.

Proposed Plan of Protecting Iron Vessels against Rust and Corrosion.—MM. Dance and Bertin.—The plan proposed by these gentlemen for this purpose, is to convert the hull of the iron vessel into a galvanic battery by placing, inside the hull, pipes and tanks made of zinc and filled with sea-water, and connected, by means of bolts and rivets in metallic contact, with the outer side of the vessel. The authors of this paper also propose the use of strips of zinc on the iron plates of the vessel immersed in the water.

Correlation of the Unequal Visibility of Colours at Twilight, and their Unequal Photographic Activity in Full Daylight.—M. Keller.—The author observes that, after sunset, those colours which are the brightest when seen by daylight, become very dark—for instance, red, orange, and yellow; while blue, violet, and indigo, which are less bright when seen by daylight, become whitish (*blanchâtres*) in twilight. The author further observes that, in a photographic print, the first-named colours produce black, and the last-named grey. White light, producing all vibrations, is capable of exciting all colours; but, since, according to the researches of the Rev. Father Secchi, S.J., the light of the sky after sunset is especially rich in blue rays, it need not excite astonishment that the less refrangible rays should be, as it were, extinguished.

Action of Permanganate of Potassa upon Cinchonine.—MM. Caventon and Willm.—The principal products of the reaction of a very cold solution of permanganate of potassa added, *guttatim*, to a cold solution of cinchonine, slightly acidified with sulphuric acid, are:—(1) An indifferent, neutral compound, which unites with bases as well as with acids, which has been named by the authors, *cinchotéinine;* (2) an acid capable of being obtained in crystals, which is named *carboxycinchonic acid;* (3) a substance which reduces the tartrate of copper and potassa. In addition to these compounds, the authors state that they have discovered, by this reaction, a new alkaloid, which is made up according to the formula $C_{20}H_{26}N_2O$, and which is named *hydrocinchonine*. This base fuses at 268°, cinchonine fusing at 257°; the former base is insoluble in water, difficultly soluble in strong alcohol at ordinary temperature, and more readily so in boiling alcohol. Cinchonétine, $C_{18}H_{20}N_2O_2$, is a solid substance, soluble in boiling water. Carboxycinchonic acid, $C_{21}H_{14}N_2O_4$, is a solid substance, pretty readily soluble in water, and obtainable in crystallinel state: it is a bibasic acid which forms with alkalies and baryta very soluble salts.

August 6, 1869.

Leaving, again, the purely mathematical and physico-mathematical papers, and also the voluminous papers on the controversy about the Newton, Galileo, Le Verrier, and Chasles papers and communications, we notice the following papers:—

Laws Governing the Solution of a Substance in Two Solvents.—MM. Berthelot and Jungfleisch.—This paper is not well suited for abstraction; but the subject it treats of may be stated in a few words, while we reserve the paper for more full treatment in our pages at a future time. All chemists know that it often happens that, in order to obtain from its solution, in water, for instance, they make use of ether, or other fluids not miscible with water, to extract therefrom any substance, *e.g.*, bromine or iodine, dissolved therein; the ether thus applied acts purely by its physical properties. The authors in this paper give, at length, the results of their researches on this subject which is very ingeniously treated.

Researches on Alloys.—M. Riche.—This paper is a continuation of a series of communications on this subject by the same author. While the hardening of steel has the effect of decreasing its density, as already long since stated by M. Caron, it was thought that this same effect was produced in bronze sonorous instruments, as, for instance, the Chinese gongs. The author finds that hardening and annealing are two operations the effect of which is totally different for steel and for bronze; whilst hardening has the effect of decreasing the density of the former, it increases that of the latter; annealing, on the other hand, increases the density of steel, and decreases the density of hardened bronze. Copper, repeatedly hardened and annealed, does not perceptibly vary in density.

A New Pyrometer.—M. Lamy.—The author proposes to use pure Iceland spar, basing the use of this substance, as a pyrometer, upon the law of dissociation.

Synthesis of Glucosides.—M. Schützenberger.—We reserve this paper for full translation in our columns.

Action of Anhydrous Sulphuric Acid upon Perchloride of Carbon.—M. Schützenberger.—When in perchloride of carbon, CCl_4, anhydrous sulphuric acid is dissolved, there is instantaneously observed a smell of phosgen gas, and when the solution is heated upon a water-bath, chloroxycarbonic gas is regularly given off. When this evolution of gas ceases, there remains in the retort a fuming liquid, which, on being submitted to distillation, yields, at about 75°, the excess of perchloride of carbon; next, the thermometer rises to 130°, and at that temperature nearly the whole of the liquid distils off. The distillate is a colourless liquid, fuming in the air, and, on contact with water, instantly decomposed into hydrochloric and sulphuric acids; on being analyzed, this liquid yields results leading to the formula, $S_2O_5Cl_2$, that is, an oxychloride of sulphur. The action of anhydrous sulphuric acid upon perchloride of carbon can, therefore, be represented by—

$$S_2O_6+CCl_4=S_2O_5Cl_2+CCl_2O.$$

Gases Given Off by Fruit.—MM. Lechartier and Bellamy.—The authors prove, in this paper, that various kinds of fruit, after having been plucked from the trees—for instance, apples, cherries, gooseberries, and currants—begin to absorb oxygen and give off carbonic acid. The paper enters into lengthy quantitative details on this subject; as a proof that the quantity of carbonic acid given off by large quantities of fruit, say apples, for instance, stored up, may be considerable; suffice it to notice that five apples, weighing together 348 grms., yielded, from the 19th of January last up to the 15th of July last, 6648 c.c. of carbonic acid gas.

New Synthetical Method for the Preparation of Naphthalin-carboxylic Acid.—M. Eghis.—The author mixes monobromide of naphthaline, chloroxycarbonic ether, and sodium amalgam; and, after a complicated set of operations and purifications, obtains, as result, a solid substance, readily soluble in alcohol, ether, and boiling water, fusing at 160°, and yielding, on elementary organic analysis, results leading to the formula $C_{11}H_8O_2$. An identical substance was obtained by Prof. A. W. Hofmann, from cyanide of naphthaline derived from oxalate of naphthalamine; the body here in question was named by the last-named *savant*, menapthoxylic acid, or naphthalin-carboxylic acid.

Cosmos, July 31, 1869.

We quote from this paper a brief account of—

The Rio Vinagre.—This river has its source at a height of 3500 metres above sea level, near a very difficultly accessible spot of the volcano named the Puracé. The late Alex-

ander von Humboldt first ascertained that the water of this river contains free sulphuric and hydrochloric acids. According to M. Boussingault, this river discharges into the Rio Cauca, wherein it falls from a height of 125 metres, during every twenty-four hours, 34,784 cubic metres of water, containing 37,611 kilos. of strong sulphuric acid, and 31,654 kilos. of concentrated hydrochloric acid. The Rio Cauca, after having received the waters of the first-named river, does not feed any fish for a distance of 18 kilometres of its seaward course. The volcano Puracé is not provided with a crater, as ordinarily met with on volcanoes, but its main outlet is a longitudinal split, 2 metres in length by 1 in width; it is covered at the top with a layer of very pure sulphur of about half a metre thick. There is at all times a strong escape of gases and vapours from the main outlet of this curious trachytic mountain, accompanied by a loud noise akin to that of the blowing off of the steam of several large high pressure steam-boilers. In the island of Java there are several rivulets and small lakes also containing free sulphuric and hydrochloric acids; while in one locality on the island of Sumatra, a lake is met with which contains free nitric acid. All these phenomena are caused by active volcanic action.

The American Journal of Science and Arts, No. 141, May, 1869.

We notice from this periodical the following original papers, omitting such as relate to astronomy, mathematics, and mechanical science:—

Atomic Volumes of the Elements.—M. Frank Wigglesworth Clarke, S. B.—This is a continuation of an essay on this subject from former numbers of this periodical. The author says, in his introduction to this part:—"In a recent paper in this journal I called attention to some remarkable relations which seem to exist between the atomic volumes of certain elements in the liquid condition. Since that time, I have found similar relations between the same elements in solid state, and also between the atomic volumes of some other solid elements, of which no liquid compounds are known. A few relations between the atomic volumes of different metals have been previously observed; chief of these, we find the equality of the atomic volumes of the metals of the iron group, the similar equality connecting the platinum metals, the equality between silver and gold, and that between molybdenum and tungsten. But, as far as I have been able to learn, nothing seems to have been done towards studying the more remarkable multiple relations which connect the members of certain natural groups together." The author next proceeds to the review of the alkaline metals, quoting the specific gravities as follows:—Lithium, 0·589; sodium, 0·972; potassium, 0·865; rubidium, 1·52. Upon dividing the atomic weights of the four metals, by these specific gravities, we get, as their atomic volumes, respectively, the numbers 11·9, 23·7, 45·1, and 56·2. It will be at once seen that the three highest of these values are very nearly multiples by whole numbers of the lowest. The author reviews, next, the oxygen group, oxygen, sulphur, selenium, and tellurium; after this, the nitrogen group, the carbon group, and metals. The very brief sketch given here may, perhaps, be followed by a more full and extended abstract in our journal afterwards.

On some Minerals from Newlin Township, Chester Co., Penn.—S. P. Sharples.—The first mineral described is *Diaspore*, containing, in 100 parts:—Silica, 43·56; alumina, 38·16; water, 5·64; potassa, 10·81. Specific gravity, 2·87. Colour varies from white to greenish or yellowish; it fuses before blowpipe-flame with extreme difficulty, forming a white enamel. *Lesleyite.*—Colour, white to reddish; hardness, about three; streak, white; before blowpipe-flame, loses water; does not fuse with borax; does not dissolve in hydrochloric acid; is specifically heavier than quartz, its specific gravity being 3·203. It contains, in 100 parts:—Silica, 43·59; alumina, 55·41; potassa, 7·43; water, 4·30. *Pennite* contains in 100 parts:—Silica, 30·20; [illegible] 14·88; alumina, 20·55; magnesia, 1·28; potassa, 11·35; water, 11·73.

Note upon the Origin of the Phosphatic Formation.—C. U. Shepard, sen.—The formation here alluded to is a very extensive one found in Southern Carolina. The paper is entirely of geological interest only.

On some Derivatives of Trichlormethyl-sulphon-Chlorid, $(CCl_3)SO_2Cl$.—M. O. Loew.—This paper will be given *in extenso* in our next number.

Notes on the Occurrence and Composition of the Nodular Phosphates of South Carolina.—C. U. Shepard, jun.—It appears that the specific gravity of this phosphatic mineral varies from 1·94 to 2·54; the quantity of water varies from 5·60 to 9·15; carbonic acid varies from 2·55 to 6·62; sulphuric acid, from 1·8 to 25·7; phosphoric acid, from 24·95 to 30·17, all in 100 parts. The mineral contains, besides lime, alumina, oxide of iron, magnesia; sand, varying from 4 to 15·7 per cent; and traces of chlorine, fluorine, and sodium. The author adds the analysis of the water of an artesian well, at Charlestown, S. C. This well is 1250 feet deep; the temperature of the water at the spout is 87° F. Specific gravity of the water, at 15°, is 1·0015; the amount of solid ingredients in the water=0·228 to 0·234 per cent. In 100 parts of solid ingredients are found:—Bicarbonate of soda, 52·749; chloride of sodium, 47·051; bicarbonate of lime, 0·0883; bicarbonate of magnesia, 0·01375; silica, 0·00102; phosphates of lime, iron, and alumina, 0·0004; organic matter, 0·0017. In 100 imperial gallons of this water at 15° are contained about 1¼ lbs. of bicarbonate of soda, and 1¾ lbs. of common salt.

Certain Phenomena of Transmitted and Diffused Light.—Carey Lea.

The Cohahuila (Mexico) Meteoric Irons of 1868.—Mr. J. Lawrence Smith.—It appears that the region of Mexico bordering on Texas has been most profusely furnished with these celestial visitors; six masses, weighing, respectively, 290, 430, 438, 550, 580, and 654 lbs., have been brought to the United States. They are irregular compact masses, without any evidence of stony minerals; they belong to the softer irons, not difficult to cut with a saw. A sample taken from one only of these masses has been as yet submitted to research. Specific gravity, 7·692. It contains, in 100 parts: Iron, 92·95; nickel, 6·62; cobalt, 0·48; phosphorus, 0·02; copper, a very minute quantity.

On Atomic Ratio.—Mr. Josiah P. Cooke, jun.—This paper treats on the so-called oxygen ratio used by mineralogists, and is more a mineralogical than strictly chemical paper.

Formation of Sugar in the Liver.—Dr. George F. Barker.—A physiologico-chemical essay.

This number of the periodical contains, as usual, a copious amount of scientific intelligence, but, since this is chiefly a reproduction from European prints, or is otherwise of local interest only, we do not notice it, the more so as there is nothing therein contained of interest which has not already been noticed by us in our journal.

Annalen der Physik und Chemie, von Poggendorff, No. 6, 1869.

This periodical contains the following original papers:

Cohesion Exhibited by Rock-Salt in Different Crystallographical Directions.—Dr. Sohncke.—The author of this paper gives an account of his experiments on the resistance exhibited by rock-salt to tractive forces, applied thereto in a similar manner as is done to wood, metallic wires, and other solids. The paper is, however, not well suitable for proper abstraction with due justice to the author's labour, and could not, moreover, be well understood without the reproduction of a large number of tables.

Description of a Photometrical Method of Measurement and Comparison of the Intensity of [illegible] Light.—M. C. Vierordt.—A large-sized em[illegible]per.

Isolating Intermediate Layer (Zwischenschicht) of a Condenser.—M. W. von Bezold.—A mathematico-physical essay.

Point of Solidification of the Component Portions of Fluid Mixtures.—C. Schultz.—The author proves, by quoting a large number of instances, that, in a mixture of solid bodies which are miscible in a fluid state, without thereby calling forth chemical reactions, a return to the fluid state, may, and actually does, take place at a temperature below the melting-point of the most easily melting substance. This fluidization takes place more readily, and with a less amount of absorption of heat, when the temperature, at the time of making the mixture, is so high that one of the component parts thereof is already fluid, as, for instance, is the case when salts are dissolved in water, or in alcohol, and when amalgams are mixed with mercury. The author of this paper records a large number of substances he has experimented upon.

Freezing Point of Water containing Gases in Solution, and on the Regelation of Ice.—M. Schultz.—The author states that, as a general rule, the point of solidification of fluids is lowered by substances dissolved therein, and that gases dissolved in fluids exercise the same effects. The fusing point of pure acetic acid is 16°; this is lowered to 15·2° when a current of carbonic acid is transmitted through this acid. That hydrochloric acid gas and ammonia gas do lower the freezing temperature of the water they are dissolved in is a well-known fact; carbonic acid and sulphurous acid gas do the same; and the author found that nitrogen, oxygen, and hydrogen gases exert, when dissolved in water, the same effect. The author records a series of experiments made by him with the view of ascertaining the effect of an increase of pressure brought to bear upon the absorption of various gases by water, and the lowering of the freezing point of that liquid in consequence thereof. By the phenomenon of regelation is understood that property exhibited by ice of freezing together to a solid mass, when pieces of that substance are pressed together at the temperature of 0°. After quoting the opinions of Messrs. Faraday, Forbes, Thomson, and Helmholtz on this subject, the author says—When we take it for granted that regelation is the formation of ice from water anew, we must bear in mind that only pure water, or water, at least, not saturated with air, is suitable for this purpose. The author has studied the influence divers gases exert upon this phenomenon, but the description of his experiments is too lengthy to admit of further quotation.

Fluids Enclosed in Minerals.—M. Vogelsang.—This paper is an appendix to a paper on the same subject published in a former number of this periodical. The chief result of the author's researches is the fact that fluid carbonic acid is far more generally met with enclosed in large masses in stone, and that the conditions under, or during which that condensation took place, are as yet only very scantily known.

Influence which Mechanical Changes Exert upon the Capability of Magnetical Rotation of some Substances.—M. R. Lütge.—This essay is entirely of a mathematico-physical nature, and there belong to it a series of engravings, which render the paper not well suitable for abstraction.

Application of a Steel Magnet, armed with a Wire Spiral, to the Dynamo-Electrical Machine.—Dr. Sinsteden.

Improved Arrangement of Leclanche's Element, and a New Self-Acting Commutator.—Dr. Sinstéden.

On Laxmannite, a New Mineral from Beresowsk.—M. Nordenskjöld.—While making some researches on minerals containing vanquelinite, met with in the large mineralogical museum at Stockholm, the author found a mineral containing a double salt of chromic and phosphoric acids, which mineral he has named laxmannite, in honor of the late Professor Laxmann, who, while making a journey through Siberia, in the year 1773, brought back to Sweden a great number of minerals from the former country and from the Ural mountains. Laxmannite has a specific gravity of 5·77; its colour is dark olive-green; on heating, it loses a very slight amount only of water, fuses before the blowpipe-flame, yielding a blackish-coloured bead. When treated before blowpipe-flame with boracic acid and iron wire, it exhibits the well-known reaction for phosphoric acid; while, on being fused with soda and saltpetre, it exhibits the reaction for chromic acid; it is soluble in nitric and hydrochloric acids, chloride of lead being separated thereby. The formula of this mineral is—

$$(CuO\tfrac{3}{4}H\tfrac{1}{4})_3PO_5 + 3(PbO,CuO)_2{}'CrO_3;$$

and it consists, in 100 parts, of:—Oxide of lead, 61·48; oxide of copper, 13·13; chromic acid, 16·57; phosphoric acid, 7·83; water, 0·99.

Behaviour of the Iodates and Periodates when Submitted to Heat, and the formation of the latter from Iodides by means of Peroxides.—M. C. Rammelsberg.—The author first points out a very remarkable difference between the iodate of potassa and the iodate of soda; the former salt, when heated, yields oxygen and iodide of potassium; the latter salt crystallises, containing 8·33 per cent of water, which is driven off at 150°. Various experimenters have stated that this salt always loses iodine when heated; others, again, have denied this. The author finds that, unless the iodate of soda is, previous to being heated, mixed with carbonate of soda, iodine is always set free. As regards the periodates, the author has submitted a number of them to properly-defined higher temperatures, and found that periodate, of potassa remains unchanged, even at 200°, but at 300° it is entirely changed into iodate of potassa. The periodate of silver changes, at 175°, into iodate of silver; normal periodate of ammonia detonates on being strongly heated, yielding iodine, nitrogen, oxygen, ammonia, and water. The author has devoted a large portion of this paper to a record of his experiments on the action of iodine upon baryta and the peroxide of barium. Curiously enough, these researches have brought to light the fact that pure baryta is by no means so readily obtained as one might feel inclined to imagine, even though the product of the ignition of nitrate of baryta contained only very minute traces of silica and alumina. The author found that there is about 3 per cent deficiency therein, for, instead of finding Ba 89·54 per cent, he found Ba 86·36 per cent, and even less; and he is inclined to assume the existence of a compound Ba_3O_4; on treating baryta with iodine at higher temperature, compounds were obtained consisting, in 100 parts, of :—Ba, 58·6, I, 32·0; Ba, 56·8, I, 34·1; Ba, 57·0, I, 33·8. These compounds all contain oxygen, and the author gives the formula $Ba_3I_2O_4$. Peroxide of barium behaves in a similar manner with iodine.

Formation and some of the Reactions of the Periodates.—M. Philipp.—This paper is a lengthy essay on this subject, and too full of formulæ to admit of useful abstraction.

On the Krahenberg Meteorite, fallen on the 5th of May, 1869.—M. vom Rath.—It appears that, on the date just alluded to, there fell, at a small village in the Bavarian palatinate, near to Deux-Ponts, a meteoric stone, accompanied by a strong detonation. The author describes this stone at length, and also describes his method of analysis of this stone. In 100 parts, it consists of:—Chromate of iron, 0·94; sulphur, 2·25; iron, 3·47; silica, 43·29; alumina, 0·63; magnesia, 25·32; lime, 2·01; protoxide of iron, 21·06; protoxide of manganese, a trace; soda, 1·03. The specific gravity of this stone is 3·4975 at 18°. The analysis just quoted has been made after a portion of the pulverized stone had been repeatedly treated by means of a magnet to extract metallic iron and nickel; the powder thus separated by the magnet was found to consist, in 100 parts, of—Iron, 84·7; nickel, 15·3. The weight of the entire meteorite was found to be about 30 lbs.

Bulletin Mensuel de la Société Chimique de Paris, July, 1869.

This periodical contains the *procès verbaux* of the meetings of this Society, held on the 7th and 21st of May last, from which we learn that M. Silva described—

Some Compounds of Isopropyl.—The valerianate of isopropyl boils at 142°; its specific gravity, at 0°, is 0·870; and its vapor density 5·04. The author has tried to prepare trisisopropylamine; he obtained, however, a liquid exhibiting a strongly alkaline reaction, which distils over between 80° and 120°, and which the author thinks is a mixture of di- and tris-isopropylamine. By making butyrate of silver act upon iodide of isopropyl, the author obtained the butyrate of isopropyl ether, $C_4H_7O_2C_3H_7$, boiling at 128°, under a pressure of 755 m.m. The specific gravity of this fluid, at 0°, is 0·8787; its vapor density, as found by experiment, is 4·730. By causing nascent hydrogen to act upon the monochlorhydrine of the amyl-glycol, the author has obtained a product very much resembling amylic alcohol, as was discovered by analysis.

Synthesis of Glucosides.—M. Schutzenberger has tried to effect this by boiling a solution of *saligénine sodée* in benzine with triacetic glucose, which is slightly soluble in that liquid; and, by evaporating the filtrate on a water-bath, a substance was obtained which is viscous at 100° and solid when cold. This compound answers the characters of the glucosides; it is split up into glucose and salicetine, yielding then, also, acetic acid. This glucose is, however, a modification of that substance known as glucosane; its reducing power is less strong than that of ordinary glucose. The residue insoluble in benzine is entirely soluble in water, with the exception of a small quantity of resinous matter; the aqueous solution yields to ether a crystallisable compound, which possesses all the characteristics, also, of a glucoside, but does not contain acetic acid; its composition is $3C_{14}H_{22}O_3,C_6H_9O_3$.

M. Vogt stated that, while treating the chlorobenzylsulphate and chlorotolylsulphate of potassium with fusing caustic potassa, he has obtained salicylic and cresotic acids.

The following original papers are contained in this number of the above-named periodical:—

Immediate Analysis of the Divers Varieties of Carbon.—M. Berthelot.—We published in full the contents of this paper some time ago.

Comparison between the Saline Constituents of the Grease of Sheep's Wool and the Human Perspiration.—M. S. Cloëz.—In this elaborate paper, the author first reviews the researches of M. Vanquelin and M. Chevreul on this subject; he then briefly refers to M. Evrard's patent, for extracting, from the grease of sheep's wool, carbonate of potassa, which process has been brought to perfection by MM. Maumené and Rogelet, and is carried on on the large scale with success. The two last-named gentlemen, having published some scientific researches on this matter, have come to the conclusion that pure grease of sheep's wool was devoid of soda or salts of this alkali. The author of this paper proves, by a series of analyses, that although in the grease of sheep's wool potassa salts prevail, the salts of soda are not altogether absent. As instances of the composition of the saline constituents of this material, we quote, out of the large number of analyses, a couple of instances:—Grease from sheep's wool taken from animals in pasturage near the sea contained saline matter, in 100 parts, composed of—Carbonate of potassa, 84·80; sulphate of soda, 4·65; chloride of sodium, 10·45. Another sample contained, in 100 parts—Carbonate of potassa, 87·27; sulphate of potassa, 3·59; sulphate of soda, 0·68; chloride of sodium, 8·27. The saline constituents of human perspiration the author found to contain:—Carbonate of potassa, 31·82; sulphate of potassa, 11·76; chloride of potassium, 16·02; chloride of sodium, 38·54.

Relative Proportion of Alkalies found in the Ash of Divers Plants.—M. Cloëz.—This paper is valuable addition to the methods of ash analysis of plants; but the author chiefly desires to call attention to facts observed already by the late MM. Ingenhousz, Senebier, and Johnston—namely, that the same plants grown near the sea, and at remote distances therefrom, alter their saline constituents, so that, while growing near the sea, soda prevails, as a rule, over potassa, the reverse being the case while the same plant vegetates at a distance more or less remote from the sea; of this fact, some instances are given in this paper. The relation of the soda to the potassa of the ash of *Crambe maritima*, when grown near the sea, was as 960 to 1000; when grown at Paris, as 89 to 1000. The relation of soda to potassa in the ash of black mustard seed grown near the sea was as 200 to 1000, while when grown at Paris, it was as 96 to 1000.

Supersaturation and Dissolution.—M. Lecocq de Boisbaudran.—This paper is a critical review of a paper published in the *Comptes Rendus*, and is not well suited for abstraction.

On Nucitannic Acid.—Dr. Phipson.—The author says that he has discovered, in the epispermium of walnuts, a peculiar kind of tannin, to which he has given the name of nucitannic acid or nucitannin. It is soluble in water and in alcohol; is precipitated by subacetate of lead; while its most remarkable property is that, when boiled with dilute acids it is split up into glucose, and a reddish-coloured substance, called by author *rothic acid*, since it has acid properties, and is soluble in ammonia and alcohol. The nucitannic acid is accompanied by ellagic and gallic acids, which interfere, the author says, with the purifying of the nucitannic acid; about the latter, and about rothic acid, the author promises further communications when his researches shall be complete.

Chemisches Centralblatt, No. 26, June 30, 1869.

This number does not contain any original papers, and the whole of its contents have been noticed by us previously from the originals.

Moniteur Scientifique, No. 302, July 15, 1869.

This paper contains a very lengthy essay on—

Designolle's Gunpowder.—M. Jouglet.—The paper is evidently written with the view to bring, if possible, into general use a powder containing picrates, in addition to nitrate of potassa. The paper is too much an essay written for artillery purposes to render it peculiarly suitable for abstraction; but, incidentally, the author speaks of nitroglycerine, and, while on this subject, he positively asserts that nitroglycerine, even when well and carefully made, is spontaneously altered by keeping, becoming acid, and then disengaging gas. This the author asserts is the true clue to the fearful explosions now and then witnessed with this material; and he concludes that if it is to be used at all, it should be made on the spot where it is wanted, and only in such quantities as may be required for blasting during one, or at most two days before.

Among the specifications of French patents, we notice the patent granted to M. Collas, for the—

Application of Phosphate of Lime for Dyeing and Calico Printing.—The author calls attention to the fact that phosphate of lime yields, with various vegetable colours, lakes which are different from those obtained with alumina; that the oxides of copper and cobalt yield, with the freshly-precipitated phosphate of lime, blue-coloured lakes, which greatly surpass, in richness of colour, Thénard's and other blues. The principle of this patent has been long enough known, and, as well remarked by the editor of this paper, it is very questionable whether this matter should be subject to any patent at all.

...n Chemical ...er lengthy

[English Editor

description of a complicated set of apparatus intended for heating the laboratory in winter, and, at the same time, supplying at all times a drying stove for filters, &c. The paper describes two kinds of apparatus, in one of which heated air, while in the other steam is applied. It does not, however, appear, from the description, that anything decidedly good is effected by these apparatus, which, from the complicity of construction, cannot but be very expensive; moreover, to be well and readily understood, this paper ought to have been accompanied by a woodcut.

Tinning by the Moist Way.—Dr. Hillier.—It is a well-known fact that, when it is desirable to cover metals, especially brass or copper, with a strongly-adhering coating of tin, this is usually effected by boiling the articles to be thus coated with an aqueous fluid, to which is added cream of tartar, crystallised protochloride of tin, and some lumps of pure metallic tin. The author states that, instead of this mixture, he uses, with very good success, a solution of 1 part of protochloride of tin in 10 parts of water, to which he next adds a solution of 2 parts of caustic soda in 20 parts of water; the mixture becomes turbid, but this does not affect the tinning operation, which is effected by heating the objects to be tinned in this fluid, care being taken, at the same time, to place in the liquid a piece of perforated block-tin plate, and to stir up the fluid during the tinning with a rod of zinc.

Annales des Mines, No. 2, 1869.

This periodical contains the following original papers:—

Some Peculiarities in the Working and Manufacture of Bessemer Steel in Styria and Carinthia.—M. Clérault.—The author of this paper states that, owing to the special advantages due to the excellent iron ores of the countries above named, the manufacture of steel, according to Bessemer's method, is effected with less cost, and yields better results, than is the case elsewhere. The paper is full of practical matters, especially as regards the manufacture of railway iron.

Certain Peculiarities of the Blast Furnaces of the Siegen District.—M. Douville.—The author of this short memoir describes the peculiarities of the blast furnaces established a few years ago in this district of Prussia, wherein, centuries since, iron-works have been in existence, but where only recently the use of coke has been substituted for that of wood. The author's paper is valuable chiefly to ironmasters.

Geological Description and Account of the Mineral Resources of the Canton de Vic Dessos.—M. Mussy.—This is the third and concluding portion of a lengthy monograph exposing the mineral resources, and describing the geology, of that portion of the French Département de l'Ariège, which is contiguous to the republic of Andorra, a country wherein mineral wealth abounds. The paper is an excellent monograph on such a subject.

Journal fur Gasbeleuchtung, June, 1869.

This periodical contains an excellent monograph on photometers and their applications under the title of—

Photometrical Studies.—Dr. Rüdorff.—The author's memoir is too lengthy, and enters too deeply into mathematical details, to render it suitable for abstraction, but it is, in every respect, an excellent essay on this subject, and duly applied to practical purposes also.

This number contains the first portion of the report of the annual meeting of German gas engineers, held this year at Cobourg. From this report, we learn that, when hydrate of lime is saturated with carbonic acid, it is yet, provided it be moist, capable of taking up sulphuretted hydrogen very energetically, without thereby simultaneously giving off again carbonic acid gas. One of the members of this Association explains, in a few words, that the removal of sulphur from the oxide of iron used in the purifiers may be advantageously effected by means of quicklime; but no particulars of this process are given.

Les Mondes, July 29, 1869.

We notice from this paper:—

The Champonnois Press.—The name of M. Champonnois as an indefatigable industrial genius, is well and very deservedly known to all acquainted with the manufacture of beet-root sugar especially. We learn, from a short notice in the above-named periodical, that the gentleman just named has succeeded in bringing out a very greatly improved press for forcing the saccharine juice out of beet-root pulp so as to obtain a larger quantity of saccharine matter from a given weight of pulp, and also to bring the juice to a state of clearness (that is to say, absence of suspended matter) not hitherto obtained. Experiments with this kind of press, which is worked, moreover, with great economy of power, and yet with enormous force, may be witnessed at the works of MM. J. F. Cail and Co., Quai de Grenelle, Paris, where a large number of these presses have been made to order by beet-root sugar manufacturers, to be applied in the ensuing season.

The Academy of Exact Sciences at Madrid has proposed the following prizes to be distributed in 1871:—To discover the best method of making starch in Spain. Description to be given of the divers varieties of vines cultivated in certain parts of Spain, excepting always the provinces of Asturia, Pontevedro, Biscaya, and Castellon de la Plana. Description to be made of the various rocks met with in one province, at least, of Spain; to indicate their *detritus*, and to point out how this *detritus* contributes to the formation of the agricultural soil in general, and in how far this soil is suitable to the cultivation of trees. The premiums for the approved memoirs are a gold medal and a sum of 1575 francs (£63). The memoirs (written in Spanish, Latin, or French) must be received by the Secretary of the Academy, on or before the 1st of May, 1871.

The Journal of the Franklin Institute, June, 1869.

A large portion of this excellent periodical is devoted to engineering facts. Among the original communications relating to chemistry we find:—

Sugar and Starch from Sweet Potatoes.—M. H. Bartol presented, at the last meeting of this Institute, samples of sugar and starch, and the following analysis made in November last, from the juice of North Carolina sweet potatoes (per cent):—Sugar, 10·50; starch, 6·00; various salts, 1·17; gum, &c., 0·33; water, 82·00. By the use of powerful presses, 90 per cent of the weight of the potato can be obtained in juice; the density of this juice is 10° Beaumé = 1·075 sp. gr. These potatoes, the author says, will yield 6·18 per cent of sugar and 5 per cent of starch; but, by improved culture, as evidenced in Europe in the instance of beet-root, this quantity may be largely increased.

Tin in Missouri.—M. Williams.—This gentleman, in a note addressed to the editor of the above periodical, states that the granitic rocks of south-east Missouri are all more or less charged with stannic acid, so that there is a fair prospect of obtaining tin ore in quantity in that country.

The larger number of papers of this number relate to engineering and astronomy, rather than to chemistry or sciences allied therewith.

American Journal of Pharmacy, July, 1869.

This periodical contains a very large amount of excellent matter, but most of it belongs too strictly to pharmacy to be suited for our pages. We abstract the following papers:—

Bicarbonate of Ammonia as a Pharmaceutical Preparation.—W. Procter, jun.—The author begins by stating that he has used this salt as an antacid, instead of bicarbonate of soda, above which it is preferable, owing, also, to its somewhat stimulating powers. As to the formation of this salt the author says—It is well known to druggists that considerable quantities of this salt are formed on the sides of casks in which carbonate of ammonia is imported, and other portions are derived from the accidental or careless exposure of the sesquicarbonate of ammonia, whereby an equivalent of mono-carbonate is lost. It has been usual to reserve the salt thus obtained for forming acetate, nitrate, or other ammoniacal salts; but it is rarely used medicinally on its own merits. If it were sufficiently abundant or could be prepared cheaply by a direct process, it would form the best yeast powder that can be offered, since it contains a larger portion of carbonic acid than any of the alkaline bicarbonates except that of lithia, which is, of course, unsuited to this use. Bicarbonate of ammonia in its purest state is a white salt, isomorphous with bicarbonate of potassa, and possesses the same crystalline form; its composition is expressed by the formula NH_4O2CO_2,HO; its taste it saline, with a slight ammoniacal impression, and is slowly volatile when exposed, and gradually evaporates with a slight odour of ammonia; it is soluble in eight parts of water at 60° F., and its aqueous solution exhibits an alkaline reaction with syrup of violets; it is decomposed by the heat of boiling water, giving off carbonic acid; it is nearly insoluble in strong alcohol, but soluble in 60 parts of dilute alcohol; it is readily prepared on the small scale, by dissolving out the mono-carbonate from the powdered sublimed sesqui-carbonate (which consists of one equivalent of each salt) by means of alcohol of 85 per cent, in which the bicarbonate is almost insoluble. When a saturated solution of sesqui-carbonate of ammonia in water is saturated with CO_2, a quantity of the bicarbonate separates in crystals, owing to its less solubility.

Sweet Quinine.—W. Procter, jun.—It appears that, under this name, there has been thrown into commerce, by M. F. Stearns (U. S.), an article which, according to a statement made in the manufacturer's circular, appeared to be quinine associated with liquorice sugar. The author of this paper very properly states that the article in question, having been submitted by him to chemical tests, does not contain any quinine at all, but mainly cinchonine, precipitated from the sulphate, dried and triturated with an impure glycerrhizin prepared from liquorice root. The tastelessness of "sweet quinine" is due to the very difficult solubility of cinchonine, which requires nearly 4000 parts of cold water; with acid or alcoholic fluids, which salify and dissolve it, its bitterness becomes apparent.

The remainder of the papers of this excellent periodical are not suited for abstraction in our pages, for the reason already given.

Bayerisches Industrie und Gewerbeblatt, June, 1869.

This number contains, besides a large collection of official communications, among which is a well-digested and arranged law for limited liability companies, the following original papers:—

Utilisation of the Waste Products of Soda and Bleaching Powder Manufacture.—M. Zängerle.—The contents of this paper are, in some form or other, known to our readers, as this subject has been fully treated of in our columns. This paper does not teach us anything new, and therefore we quote nothing more from it than this—that, in Germany, the manufacture of sulphur from soda waste, and of peroxide of manganese containing 60 per cent, is carried out largely, and with success.

Use of the Miesbach Coal as Fuel at the Salt-work of Hall, in the Tyrol.—M. Hailer.—This paper is chiefly of local importance; but it may be noticed that the coal here alluded to, while containing 18·6 per cent of ash, and being chiefly small coal, containing, on an average, 52 per cent of carbon, is yet successfully applied to heat the salt-pans, at almost nominal cost, since the furnace is so arranged as to get the most heat from the fuel.

Jet-Black China Varnish.—M. Marx.—Under the above name is sold a varnish for boots and shoes, which, according to the author's analytical researches, chiefly consists of an alcoholic solution of shellac. According to the author, an excellent imitation of the original may be made by dissolving 10 grms. of shellac, and 5 grms. of turpentine, in 40 grms. of strong methylated spirits, in which fluid should be previously dissolved 1 grm. of extract of logwood, with some neutral chromate of potassa and sulphate of indigo. The varnish is to be kept in well-stoppered bottles.

Parisian Copying Ink.—M. Marx.—To make this, take 30 grms. of extract of logwood, and 7·5 grms. of crystallised carbonate of soda; boil this with 240 grms. of water, and add, while vigorously stirring, 30 grms. of glycerine. When the fluid has become cold, dissolve in it 1 grm. of neutral chromate of potassa, and add, lastly, 7·5 grms. of gum arabic, previously made into a thick mucilage with water. The paper upon which it is desired to transfer a copy need not be moistened if this ink is used.

Mixture for Producing "Japanese Lightning."—M. Marx.—Anhydrous saltpetre (nitrate of potassa), 33·3 parts; charcoal from lime-tree wood, 58·3; flowers of sulphur, 8·4. As to the name of Japanese lightning, it means the same as the Japanese matches Prof. A. W. Hofmann spoke about a couple of years ago, at a meeting of the Chemical Society.

Zeitschrift für Chemie, von Beilstein, No. 13, 1869.

This number contains only one original paper, the great bulk being abstracts from various periodicals written and published in English, French, Italian, and German languages. The original paper alluded to is on—

Hæmatoxyline and Hæmateine.—D. Tabensky.—The author states that, since MM. Erdmann and Hesse had discovered that hæmatoxyline reduces solutions of silver and becomes coloured red by the action of direct sunlight, he was induced by Prof. von Babo to make some experiments in order to discover whether the alcoholic extract of logwood might not be very serviceable in photography. For this purpose the author prepared hæmatoxyline in pure state according to Erdmann's method, taking care to re-crystallise the substance repeatedly from an alcoholic solution. Next, two glass plates, properly prepared, were exposed, in a photographic apparatus, to light, and afterwards one of these plates was treated, as usual, with pyrogallic acid, the other with a solution of hæmatoxyline. The success of the latter operation left nothing to be desired, and the further experiments of the author leave no doubt whatever that hæmatoxyline may be advantageously applied in photography. The quantities best suited for this solution are as follows:—Hæmatoxyline, 0·5 grm.; distilled water, 80 grms.; 22 grms. of acetic acid of 33° strength; and a small quantity of glycerin. The method of preparation of hæmateine has been altered and improved by the author of this paper in the following manner:—By means of an aspirator, air is drawn through a bottle filled, for one-third of its capacity, with liquid ammonia; and the current of air thus charged with ammonia is made to pass slowly over and through hæmatoxyline suspended in water; but care is to be taken that the glass tube through which the air charged with ammonia strikes should only just dip very slightly under the surface of the water; by this means, excess of ammonia is excluded, and the formation of amorphous brown substance is prevented. By this method, from 10 to 12 grms. of hæmatoxyline are changed, within three hours, into hæmateine, yielding a magnificently purple-coloured solution, which is precipitated by bisulphite of ammonia when cold; but, on heating, this precipitate becomes re-dissolved. Hæmatoxyline is, accord-

ing to M. Hesse, composed of $C_{32}H_{14}O_{12}+2HO$; hæmateine is $C_{32}H_{12}O_{9}+HO$. The former substance is a very weak acid, rather difficultly soluble in water, but very readily in an aqueous solution of borax; it is best and easiest prepared from the extract of logwood met with in commerce.

On Dichloraldehyde.—M. E. Paterno.—This paper, being taken from an Italian periodical which does not come to England, is therefore abstracted. The author states that he treated dichloraldehyde with chloride of phosphorus, with the view thus to obtain the chloride $CHCl_2—CHCl_2$; but this was not the result of the reaction between the two substances just named: a product was obtained which boils at 250°, and which, on being submitted to elementary organic analysis, gave results leading to the formula $C_4H_4Cl_6O$. The constitution of this substance is apparently that of an ethyliden-oxychloride, the composition of which is to be indicated by either of the two following formulæ:—

$$CHCl_2—CH_2—O—CCl_2—CHCl_2.$$

or by—

$$CHCl_2—CHCl—O—CHCl—CHCl_2.$$

The substance, $C_4H_4Cl_6O$, is a somewhat coloured oil, heavier than water, soluble in alcohol and ether, boiling at 250°, and giving off very irritating acid fumes; on being mixed with an alcoholic solution of caustic potassa, a very violent reaction ensues, and, on addition of water, an aromatic-smelling oil is separated, which boils at 196°, and has the formula $C_4H_2Cl_4O$. This substance combines readily with bromine, forming a solid crystalline substance fusing at 60°, and having for its formula $C_4H_2Cl_4Br_4O$. Dichloraldehyde is not readily oxidised; when its vapour, mixed with air, is passed through a tube containing spongy platinum, no perceptible change ensues; mixed with its own bulk of red fuming nitric acid, a very energetic reaction sets in; when this has somewhat subsided, and the excess of nitric has been expelled by evaporation, and the residue is submitted to distillation and rectification, dichloracetic acid is obtained, which boils at about 195°, and yields, when distilled with a mixture of concentrated sulphuric acid and alcohol of 90 per cent, pure dichloracetic ether boiling at 155°.

Crystallised Digitaline.—M. Nativelle.—This alkaloid is obtained in crystalline state in the following manner:—100 parts, by weight, of coarsely-powdered *herba digitalis* is mixed with a solution of 25 parts of acetate of lead in 100 parts of water, left standing for twelve hours, and then exhausted with water; the residue is treated with alcohol of 50° until the solution thereof is free from any taste. The solution thus obtained is treated with a solution (aqueous) of four parts of acetate of lead, and filtered. To this filtrate is next added a solution of two parts of phosphate of soda, again filtered, and the alcohol removed by distillation on a water-bath. It will be observed that, in the residue of the distillation, there are suspended, in the aqueous fluid, small crystals, surrounded by a yellowish-coloured, very bitter-tasted substance. The residue of the distillation is concentrated, by evaporation on a water-bath to about ten parts, next filtered, washed with cold water, the precipitate dried by pressing it between folds of filtering paper, dissolved in about twice its weight of alcohol of 60 per cent, and put by in a cool place. While thus standing, two different sets of crystals are separated—first, those of an inactive substance; next, after some days, yellowish-coloured crystals of digitaline. After these have been fully formed, the mother liquor is run off, and the crystalline mass is taken up with alcohol of 80 per cent, while, at the same time, some animal charcoal is added The solution, having been filtered and left to evaporate, is treated with pure chloroform, and strongly shaken up with it; the digitaline only is dissolved. On distilling off the chloroform, a somewhat coloured digitaline is obtained, which is further purified by repeated treatment with alcohol and animal charcoal. The crystalline digitaline is a neutral, non-nitrogenous, inodourous substance, of very bitter taste readily soluble in chloroform, while one part of this digitaline requires twelve parts of alcohol of 90 per cent for its solution at the ordinary temperature; it is slightly more soluble in boiling alcohol, but far less soluble in absolute alcohol and in pure ether, and, practically, entirely insoluble in water at any temperature. Sulphuric acid dissolves this substance, yielding a greenish-coloured solution, which, on contact of vapours of bromine, becomes *groseille* red coloured; but addition of water restores the original green colour. Hydrochloric acid, also, dissolves digitaline, exhibiting, likewise, a green solution, from which water precipitates a resinous matter. The result of the elementary organic analysis of digitaline led to the formula $C_{25}H_{40}O_{15}$. The other crystalline substance above mentioned is insoluble in chloroform, soluble in alcohol; crystallises in colourless needle-shaped crystals which are devoid of taste, neutral to test papers, free from nitrogen, less soluble in alcohol than digitaline, and practically insoluble in water and ether. With sulphuric acid, this substance yields a *groseille* red coloured solution, which turns yellow on addition of water; nitric acid dissolves this substance to a colourless fluid, while hydrochloric acid is hardly capable of dissolving it at all. There is no elementary organic analysis as yet made of this substance, but it has been ascertained to be free from nitrogen.

Polytechnisches Journal von Dingler, first number for July, 1869.

This number contains the following original papers:—

On Stoves suitably constructed to Burn Coal as Fuel for Heating Rooms in Dwelling-Houses.—M. W. Hohbach.—The author describes, at length, an excellently arranged stove, by the use of which economy of fuel and proper supply of fresh air to the room are secured. A stove of medium size is so arranged that with from 15 to 20 lbs. of coal, a room of 12,000 cubic feet capacity is kept heated to 16° Réaumur (=20° C., and 68° F.) for from eight to twelve hours. The construction of this stove could not be well understood without the reproduction of the engravings accompanying the original.

Chemical Composition of Native Chrome Iron Ore.—M. Clouet.—After referring to the kinds of rock wherein this ore occurs, the author states that all varieties of chrome iron ore which have been hitherto analysed exhibit a constant and definite chemical composition. As instances, he quotes the following analysis:—$FeOCr_2O_3$, Russian ore, as, also, Smyrna and Norway (Drontheim); $2FeO,Cr_2O_3$, Ile à Vaches, St. Domingo; $2FeO,3Cr_2O_3$, Russia (another district); $4FeO,5Cr_2O_3$, the Banat (Alt-Orsowa); $8FeO,5Cr_2O_3$, India; $6FeO,5Cr_2O_3$, California; $3FeO,2Cr_2O_3$, Australia. A sample of pure crystalline octahedrical ore from the Ile à Vaches was found by the author to consist, in 100 parts, of—Oxide of chromium, 51·53; protoxide of iron, 48·46. Formula, $2FeO.Cr_2O_3$. The author enters, at great length, into particulars about the analysis of chrome iron ores; but, since any good treatise on analytical chemistry may be consulted on this subject, we do not notice this part of his paper here any further.

Manufacture of Hyposulphite of Soda from Soda Waste.—M. Schaftner.—This paper is entirely a lengthy description of a manufacturing process on the large scale. The main facts are—that, to the soda waste, sulphate of soda is added; and, after this mixture has been exposed for some time to the influence of the air, it is lixiviated with water. Sulphur is obtained as a by-product.

Contribution to our Knowledge of the Relation of Carbon to Oxygen.—Dr. Richters.—This paper is far too lengthy for any useful abstraction. The chief point thoroughly elucidated by the author is the oxidation of coal, charcoal, and coke at comparatively low temperatures.

On Balata.—M. Sperlich.—Balata is the inspissated milk-juice of the *Sapota muelleri*, a tree met with in large numbers in the three Guianas. Balata appears to hold a middle place between caoutchouc and gutta-percha. The author obtained the raw material, and, after having first

treated it with boiling acidulated water, next with absolute alcohol, he dried the substance, and next dissolved it, with the aid of gentle heat, in sulphide of carbon. After removing that fluid by distillation, the balata was repeatedly boiled with a mixture of ether and alcohol, well dried and submitted to elementary analysis, yielding, in 100 parts, 88·49 of carbon and 11·37 of hydrogen, and, therefore, pretty nearly the composition of purified gutta-percha, which gives 87·91 of carbon, and 11·94 of hydrogen.

Use of Maize (Indian Corn) for Distillation of Spirits in Hungary.—Dr. Schultze.—This paper is chiefly written for distillers. The use of maize is a good idea. Curiously enough, experience appears to have taught that this grain requires, after having been ground to meal, to be steeped for about twenty-four hours in water containing sulphurous acid gas in solution. The next operation is the boiling of the meal, after which it is, when sufficiently cool, mixed with green barley malt. The quantity of spirits obtained from this material is large, and the quality good.

Alloys for Bells.—M. Lichtenberger.—It appears that for some time there have been met, in the trade in Germany, clock-bells of excellent and loud silvery tone; the author of this paper was induced, therefore, to analyse—(1) the metal the bell of a large-sized house-clock is made of, (2) a smaller bell, (3) bells for horse-harness, and (4) an ordinary small yellow-metal bell; the results are as follows:—

	No. 1.	No. 2.	No. 3.	No. 4.
Copper.....	83·22	83·09	84·50	79·90
Tin.....	16·76	16·80	15·42	20·03

The Nos. 1 to 3 are from the same manufactory.

New Method of Bleaching Feathers.—M. Duflot—This process is an entirely newly-discovered one, whereby the feathers of ostriches and other birds may be bleached, even if these feathers are naturally black or dark grey-coloured. The feathers are placed for from three to four hours in a tepid dilute solution of bichromate of potassa, to which, cautiously, some nitric acid has been added. After this lapse of time, the feathers will be found to have assumed a greenish hue, owing to the oxide of chromium precipitated on the substance; in order to remove this, the feathers are placed in a dilute solution of sulphurous acid in water, whereby the feathers become perfectly white and bleached. Care is to be taken that the solution of bichromate be not made too strong, and, especially, that not too much nitric acid be used, which would cause an irremovable yellow colour.

Annales du Génie Civil, July, 1869.

This number does not contain any papers or communications relative to chemistry, but we learn from it the—

Abolition of Patents for Inventions in the Netherlands.—A law has been made cancelling the old patent law of 1817; and, though all existing patents remain in force, no new ones are to be any more granted from and after the 1st day of August, 1869.

Moniteur Scientifique, August 1, 1869.

This number contains the following original papers:—

On the Cooling Down of the Sun.—M. Lecoq.—This is a very lengthy, and rather speculative treatise on a subject partly belonging to astronomy, and partly to physical geography. The author deserves great credit for the lucid manner of his exposition; but we cannot enter into details on this matter, however interesting it may be.

Quantity of Heat Developed in Interrupted Electric and Galvanic Currents.—MM. Jamin and Roger.—A purely mathematico-physical paper.

On Toluol and the Alkaloid it Yields.—M. Rosenstiehl.—The greater part of the contents of this paper have been previously published, and have been quoted by us from another periodical; but we translate the last few lines of this publication for the practical value therein contained:—"Toluol is a unique and peculiar hydrocarbon, which, on being treated with nitric acid, yields, simultaneously, two nitro-derivatives (the manufacturer who desires to obtain alkaloids, in order to prepare therewith colouring matters, should take care to produce as little crystallised nitrotoluol as possible). The isomerism manifested after the action of nitric acid is maintained in its coloured derivatives. Although the two toluodines differ, as regards their chemical properties, they yield colouring matters the physical properties of which are identical. The fact of the existence of isomerism of the artificial colouring substances explains the large number of varied blue and violet matters obtained from fuchsine; this may lead to the discovery of a large number of isomers of one and the same colour; and this subject I intend to take up, experimentally, within a short time.

Fusible Alloys.—M. Stewart mixes 7·5 parts of bismuth, 4 of lead, 1·5 of tin, and 2 of cadmium, and thus produces an alloy fusing at 66°. We quote hereunder the composition of divers fusible alloys, respectively, so made that the quantity of bismuth of each is the same:—

	Newton's Alloy.	D'Arcet's Alloy.	Pelouze's Alloy.	Wood's Alloy.
Bismuth.....	600	600	600	600
Lead.....	375	300	360	320
Tin.....	225	300	240	160
Cadmium.....	—	—	—	120
	1200	1200	1200	1200

All these alloys fuse below 100°.

Under the title of—

What is Going on in Germany, we find in this periodical an excellent account briefly summarising the history, progress, and present state of the Prussian universities. The most ancient of these is that of Griefswald, founded in the year 1456; the youngest is Bonn, founded in 1818. Leaving the Austrian dominions altogether out of the question, Germany, that is to say, the North German Confederation and the Southern Independent German States, contain together 19 universities, with 773 ordinary, and 340 extraordinary professors, and 342 repetitors, and, collectively, frequented by an average of 14,383 students. Some of these institutions have large revenues; foremost among these is Tübingen, Würtemberg, with an annual revenue of 100,000 florins (about £10,000). All of these universities are under government control, and the expenses are met by regular grants made with great liberality. The population of this portion of Germany amounts to about 36,000,000, and the area, in German geographical square miles, amounts to about 10,000.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 6, August 9, 1869.

This number contains the following papers and communications:—

Evaporation of Water by Plants.—M. Dehérain.—The author states—(1) the evaporation of water from the leaves of plants is a function entirely different from the evaporation of the same fluid from a not living (inert) surface, since the evaporation from leaves of plants is not interrupted by the state of saturation of the atmosphere; (2) this evaporation is especially due to the action of light; (3) those rays of light which are most effectual in aiding the decomposition of carbonic acid by the leaves are also those which chiefly assist the evaporation of water therefrom.

Non-Poisonousness of Coralline.—M. Guyot.—This paper contains the results of an exhaustive series of experiments by which it is fully proved that coralline, neither when taken internally even in large doses nor also when brought directly into the blood, is a poison, and that its use

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in dyeing is not dangerous, provided, at the same time poisonous substances are avoided.

Some Phenomena of Decomposition Produced by Sunlight.—M. Morren.—The author, while repeating some of Professor Tyndall's experiments, but applying, instead of electric light, the bright sunlight of Marseilles's clear sky, has discovered that several inorganic substances are decomposed when a ray of sunlight is made to pass through them; among these sulphurous acid gas is enumerated, this gas being decomposed into oxygen and vapour of sulphur. This phenomenon is caused, according to the author, by a peculiar dissociation called into play by the vibratory motion of the light, which has the effect of breaking up the chemical combination; by means of spectrum analysis the author has discovered that the activity of the light in this aspect depends partly upon its colour, and partly upon the refringence and the nature of the decomposed substance. The author has also found that a thin layer of sulphate of quinine of no more than 4 or 5 m.m. thickness entirely arrests the chemical rays, as if it were a thick yellow-coloured piece of glass. The author states that the chemical effects of highly-heated platinum—for instance, the decomposition of water by that metal, are due to the accumulation of more and more refringent rays.

On the Laws which Rule the Part any Substance Plays between Two Solvents.—M. Berthelot.—This paper is, on account of the abstruseness of the subject treated of, and also because of the algebraic mode of treatment, not very well suited for abstraction with due justice to the author and the subject.

Heat Developed by the Combustion of Coal.—M M. Scheurer-Kestner and Meunier.—This paper is a continuation of a former paper on the same subject by the same authors. The coals treated are those from the Creuzot and some Belgium coals; as an instance of the composition in 100 parts of the former we quote the analysis of a sample designated anthracitic by the authors:—Water, 1·76; carbon, 87·36; hydrogen, 3·47; ash, 3·63; oxygen and nitrogen, 3·75. Belgian coal from Denain, in 100 parts—water, 1·14; carbon, 77·68; hydrogen, 4·10; oxygen and nitrogen, 10·73; ash, 6·35. The observed quantity of heat of combustion of the first-mentioned sample amounts to 9409 units; that of the last-mentioned sample amounts to 9085 units.

Succinate, Benzoate, Nitrite, and Nitrate of Isopropyl.—M. R. Silva.—The succinate of isopropyl is a liquid exhibiting an agreeable but very peculiar smell; insoluble in water, soluble in alcohol and ether, inflammable at a higher temperature, boils at 228°, its specific gravity at 0° is 1·009 and at 18° 0·997. Benzoate of isopropyl is also a liquid exhibiting a very pleasant smell; insoluble in water, but soluble in alcohol and ether; boils at 218°, its specific gravity at 0° is 1·054, at 25° 1·013. Nitrite of isopropyl is an inflammable, slightly yellow-coloured, liquid, boiling at 45°; specific gravity at 0° 0·856, and at 25° 0·844. Nitrate of isopropyl is a colourless, very inflammable liquid, boiling between 101° and 102°; specific gravity at 0° 1·054, at 19° 1·036; its vapour detonates violently when strongly heated.

Transport of Artificially-Made Ice.—M. Toselli states that a solid block of ice weighing 23 kilos., and made in 18 minutes by a process invented by him, has been sent from Paris to Algeria, and received there without more than a very trifling loss by melting during this long journey in hot summer weather.

A large number of papers and communications in this number again refer to the Newton-Pascal and Chasles Leverrier controversy.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., No. 1.

This number contains the following papers relating to chemical science:—

Evolution of Ammonia Gas from Mushrooms.—M. El. Borscow.—The author says that, many years ago, the late Professor Sachs observed that when a glass rod, moistened with dilute hydrochloric acid (specific gravity, 1·12) was brought near vigorously and healthily growing mushrooms, there appears a white vapour, evidently due to the formation of chloride of ammonium. This fact has been confirmed by Dr. G. Lehman, while the late Alexander von Humboldt stated that mushrooms constantly give off, not only ammonia, but also hydrogen. The author of this paper has thoroughly investigated this subject, taking due care to eliminate all sources of error from his experiments by every precaution modern science can suggest and successfully apply. Several engravings would be absolutely necessary for the proper understanding of these researches; but we briefly notice the following results:—(1) different kinds and species of mushrooms give off, while growing vigourously, weighable quantities of ammonia; (2) this evolution of ammonia is not confined to full-grown mushrooms only, but also to the young individuals, and even to some varieties of mushroom spawn; (3) this evolution of ammonia is a proper function of the living organism of these cryptogamic vegetables, and is very little, if at all, influenced by exterior causes; (4) there is no direct relation between the quantity of ammonia and that of carbonic acid given off during a given period of time. The quantity of ammonia given off during a certain length of time bears no direct relation to the weight of the substance from which it is given off.

Malowka Coal.—M. G. Von Helmersen.—This is a geologico-mineralogical account of researches made in the Tula-Kalugaer coal district, Ural Mountains, Russia. Although the coal seam here alluded to is not suitable for working, its discovery is remarkable on account of its occurrence in the so-called Devonian system, wherein coal seams have not been hitherto found. The author does not speak of the quality of this coal, nor does he give any account of its physical or chemical properties. The paper enumerates the layers and thickness of the various kinds of rocks bored through for other mining purposes, when accidentally this coal was found.

Influence of Temperature upon the Capacity of some Metals for Conducting Heat.—M. Lenz.—The results of the author's experiments may be briefly stated. (1) the capability of conducting heat and electricity are proportional to each other when the temperature is the same; (2) the influence of temperature upon the capability of conducting electricity and heat is the same. In this point the author's results differ from those obtained by Messrs. Angström and Forbes.

On Uriylic Acid.—Dr. N. Sokoloff.—The author made nitrous acid gas pass through a mixture of 100 grms. uric acid and 300 c.c. of water at 70°; a very tumultuous reaction took place, and a large quantity of carbonic acid and nitrogen gases was evolved. The chief result of this reaction is the formation of a new acid, which the author calls urinylic acid, $C_8H_7N_7O_8$; it is a tribasic acid. The alkaline salts of this acid are very readily soluble and crystallise; the lime and baryta salts are insoluble in water and insoluble also in acetic acid; the urinylic acid itself is a yellow-coloured, strongly acid-reacting crystalline powder, difficultly soluble in water. When this acid is heated with nitric acid (specific gravity 1·30) and care taken to avoid further heating after the acid is dissolved, there is deposited from the fluid, on cooling, a new acid crystallising in needle-shaped crystals and converted by nitrous acid into a substance akin to alloxantin, but not further investigated by the author.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, April, 1869.

Among a series of essays and papers read at the meetings of this society, we find the following communications relating to chemistry:—

On the Substances which agree with (entsprechen) Essential Oil of Mustard and are Isomeric with Hydrosulpho-cyanic Ether.—Dr. A. W. Hofmann.—The author first briefly refers to a former paper on this subject, wherein he treated on the combined action of water and a high temperature upon the essential oil of mustard; he next states that when, instead of water, alcohol is made to act at a temperature of from 110° to 120°, the ether of a peculiar acid is readily obtained. The author, dividing his subject into several sections, treats—(1) on the action of ethyl alcohol on *ethylsenföl* (ethylated essential oil of mustard); (2) on the action of ethylmercaptan upon ethylcyanide; (3) action of ethylmercaptan upon *ethylsenföl*; (4) action of alcohol upon *allylsenfol* (allylated-essential oil of mustard); (5) action of alcohol upon *phenylsenfol* (phenylated essential oil of mustard); (6) action of ethylmercaptan upon phenylsenföl. We regret that, with due justice to the contents of this lengthy essay and its eminent author, we cannot enter into more details on this subject.

Contribution to our Knowledge of Methyl-Aldehyde.—Dr. A. W. Hofmann.—The author first briefly reviews his former communications to the Academy on this subject; he next refers to the labours of MM. Aimé Girard, Geuther, and Butlerow, and discusses the question whether the substance called dioxymethylen by M. Butlerow, is identical with the methyl-aldehyde directly obtained from methyl-alcohol (pure wood spirit) when its vapours are carried along with air over a red-hot platinum wire, placed in a combustion tube. The author states that dioxymethylen, which fuses at 152°, and boils at a higher temperature, cannot be considered to be the normal methyl-aldehyde, CH_2O. The author's paper is chiefly written with the view of elucidating the true bearing and relation of normal methyl-aldehyde towards other compounds which are either polymeric or isomeric with it. The paper is too lengthy and too concisely written to admit of more abstraction.

Polytechnisches Journal von Dingler, second number for July, 1869.

This number contains the following original papers:—

Researches on the Necessity of Water Supply to the Vital Functions of the Yeast Cells.—M. Wiesner.—The quantity of water contained in the living yeast cells varies from 0 to 80 per cent, but it appears that the proper functions of these minute organisms do not begin to be exerted unless they contain at least 13 per cent of water, and the greatest activity of these cells requires undoubtedly 40 per cent of water. When water is gradually withdrawn from these cells, either by drying under a desiccator, or even by a slowly rising temperature up to 100°, their vital activity is not thereby destroyed or impaired. Yeast containing only 13 per cent of water induces, in fluids containing from 10 to 20 per cent of sugar, fermentation as intensely as yeast which contains from 70 to 80 per cent of water; alcohol kills yeast, *i. e.*, impairs its capability of inducing fermentation by rapidly withdrawing the water necessary to the existence of the yeast cells. Too concentrated solutions of sugar act upon the yeast cells in the same way, and hence no fermentation can take place therein.

China Grass.—M. Unger.—This material, or fibre, is obtained from the *Urtica Nivea*, L. It is akin to cotton made up of single cells; the diameter of the fibre averages 0·05 m.m.; in air dried state this substance contains 6·52 per cent of water, but if the material is left for twenty-four hours at 20° in a space saturated with aqueous vapour, the quantity of water increases to 18·15 per cent; the quantity of ash of the dried fibre amounts to 1·70 per cent.

Peru Gum.—M. Beckerhinn.—Under this name there is brought into commerce a powder, which, according to the researches of this author, consists almost entirely of small particles possessing, when seen under the microscope, an organised texture. This texture appears to be entirely soluble in water; chemical examination of this substance gave the following results for 100 parts:—Water, 12·72; gum soluble in water, 24·27; substances soluble in alcohol, 48·69; soluble in ether, 4·16; insoluble in water, alcohol, and ether, 4·25; ash, 4·82.

Gum from Moringa Pterygosperma.—MM. Wiesner and Beckerhinn.—This gum was first brought to Paris in the year 1867, under the name of *gomme de ben-ailé*, from one of the French settlements in Hindostan. Its aspect is not unlike Senegal gum; in 100 parts it consists of—Water, 11·71; soluble in alcohol, 8·30; soluble in ether, 7·85; soluble in water, 24·85; insoluble in water, alcohol, ether, 43·86; ash, 1·81.

Annalen der Physik und Chemie, von Poggendorff, 1869, No. 7.

This number contains the following original papers:—

Spectra Exhibited by some Gases when Under High Pressure.—M. A. Wüllner.—This paper is the continuation of a monograph on this subject, the publishing of which commenced in this periodical two volumes back. It is an excellent essay, but, owing to its great length, is not well suited for useful abstraction.

Floating and Expansion of Liquids upon Liquids.—M. Lüdtge.—In the introduction to his essay, the author says, the first fact which gave rise to the scientific study of the phenomena observed when a drop of oil, for instance, falls on water, was that first observed by mariners, of the calming effects of oil poured on the surging waves of the sea in a severe gale of wind, a subject on which an excellent memoir was written and published many years ago by the eminent physicist, M. Van Beek. The author's essay is copiously illustrated by exquisitely executed engravings, but as it is only by the aid of these that the subject matter of this paper can be made intelligible, we must refrain from further notice of the subject.

Some New Antimony Minerals from Wolfach, Baden.—M. Petersen.—A portion of this paper is a geologico-mineralogical essay of local interest chiefly, of the following minerals, of which the chemical composition is given. *Stibiotriargenite.* Specific gravity, 9·611 to 9·770; in 100 parts—Antimony, 27·35; silver, 72·65. *Stibiohexargenite*, Ag_6Sb. In 100 parts—Antimony, 15·84; silver, 84·16. *Coarse-Grained Antimony-Silver.* In 100 parts—Antimony, 23·06; silver, 76·65. *Polyargyrite.* In 100 parts—Sulphur, 14·78; antimony, 6·98; silver, 76·70; lead, a trace; iron, 0·36; zinc, 0·30. *Wolfachite.* In 100 parts—Sulphur, 14·43; arsenic, 38·46; antimony, 13·17; lead, 1·32; silver, 0·12; iron, 3·71; nickel, 29·53; cobalt, a trace; copper and zinc, small traces.

Distances which Limit the Molecular Action of Capillarity.—M. Quincke. — A mathematico-physical essay.

Isodimorphism of Arsenious and Antimonious Acids.—M. P. Groth.—A purely crystallographico-mineralogical essay.

Crystallised Kainite Found at Stassfurth.—M. P. Groth.—This paper, also a crystallographico-mineralogical essay, is accompanied by several engravings. Kainite consists, in 100 parts, of—36·34 K_2SO_4; 25·24 $MgSO_4$; 18·95 $MgCl_2$; 19·47 H_2O.

Relation Existing Between Circular Polarisation and Hemiedric Hemisymmetry.—M. V. Von Lang.—Unsuitable for abstraction.

Feeble Electric Sparks in Air.—M. P. Reiss.

Vibrations of Luftplatten (thin layers of air).—M. Kundt.—Both these papers are mathematico-physical essays.

Cause of the Galvanic Phenomena of Cooling and Heating Observed by Peltier.—M. Edlund.

How can we Neutralise those Induction Currents which are Generated in the Electro-Magnetic Motors during the Rotation of the Movable Magnets, and Prevent these Currents Weakening the Full Action of the Machine?—Dr. Sinsteden.

Estimation of the Dispersion of Glycerine.—M. Listing.

Experiments made with Holtz's Induction Machine.—M. Schumacher.

Observation on the Treatise of M. R. Most, entitled a New Proof of the Second Law on Heat (Wärmegesetz).—All the papers of which the titles only are quoted are too abstruse for useful abstraction.

Journal de Pharmacie et de Chimie, July, 1869.

This periodical contains, in the first place, three papers which we do not quote, since the subject matter has been already alluded to, taken from the *Comptes Rendus*. The original papers are:—

Double Fluoride of Iron and Sodium.—M. Nicklès.—When a concentrated solution of sesquichloride of iron is added to a concentrated solution of fluoride of sodium, a white precipitate ensues, which disappears on the addition of the slightest excess of sesquichloride of iron. When to this last solution, tepid alcohol is added, a flocculent yellow precipitate is formed, which is also a double fluoride of iron and sodium, with excess of iron. Both these varieties give, on analysis, results which lead to the formula $2NaFl,Fe_2Fl_3,HO$.

New Reagent for Brucine.—M. Cotton.—When, to a solution of brucine in nitric acid, hydrosulphide of sulphide of sodium is added, in concentrated solution, the mixture becomes, first, violet, next green-coloured, provided the alkaloid is in excess. Morphia does not give any similar reaction under the same conditions; alkalies do not affect this colouration; dilute acids render it rose-coloured, while sulphuretted hydrogen is given off; 2 milligrms. of brucine impart, in this manner, a decided colouration, even to half a litre of water.

Recent Researches on the Essence of Roses.—M. Flückiger.—Chemically considered, the essential oil of roses, is a mixture of an oil containing oxygen, to which alone the smell and perfume is due, and a solid hydrocarbon, a stearopten absolutely devoid of smell, and composed according to the formula $C_{16}H_{16}$. This hydrocarbon is soluble in chloroform, fuses at 32°, and boils at 272°. Potassium does not act upon this substance; treated with a mixture of bichromate of potassa and sulphuric acid, it yields, faintly, a smell of acroleine; with fuming nitric acid, butyric, formic, fumaric, oxalic, valerianic, and succinic acids are formed.

New Apparatus for the Concentration of Sulphuric Acid.—M. Cotelle.—It is a well-known fact that the concentration of sulphuric acid in platinum vessels is an expensive process, owing to the high price of the first purchase of these apparatus, and the expense attending any soldering or repair. The author has had made a column, lined inside with fire-bricks, and made outside of good ordinary bricks; it rests on a large pedestal. This column is open at both top and bottom; but in these openings are fitted fire-clay stoppers. The inside of this apparatus is fitted with previously-calcined pumice-stone; inside the lower portion of this column, openings are made between the bricks, through which a current of highly-heated air is forced. From the top, the acid which has to be concentrated is made to trickle on the pumice-stone, and, meeting with a current of highly-heated air, the superfluous water is driven off, and the acid, on arriving at the bottom, is in a concentrated state, and runs off in properly-arranged vessels.

The remaining papers in this number are specially devoted to *materia medica* and sciences more closely connected with medicine.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, 1869, No. 11.

This number contains the report of the meeting of this society, held on the 14th of June last. It appears that this society's membership is highly valued beyond Prussia, since no less than nine new foreign members were admitted at this meeting; the following papers were read:—

On Halhydrate Water.—M. Erlenmeyer.—The author says that, many years ago, Dr. T. Graham called attention to the fact that the sulphates of magnesia, of oxide of zinc, of protoxide of iron, of oxide of copper, and the sulphates of the protoxides of nickel and cobalt, contain, besides water of crystallisation, a certain quantity of water, which belongs to, and is essentially required for, their constitution. Professor Graham called it *basic water*, and stated that it could be replaced by salts; at a somewhat later period (now, however, nearly forty years ago) the same *savant* named this water *salinic*, and distinguished between it and *basic water*, inasmuch as for the former may be substituted salts, for the latter bases. Since the year 1838, Professor Dr. J. Von Liebig has called that water contained in salts for which, according to Professor Graham, may be substituted equivalents of other neutral salts, *halhydrate water*. The author of this paper is of opinion that modern chemists have altogether forgotten this matter, and especially since it might inconvenience their mode of representing things; there exists, however, for all that, a great distinction between water of crystallisation and halhydrate water, and the author having carefully studied this point, has come to the conclusion, on theoretical as well as on experimentally proved facts, that the salts which contain halhydrate water are not neutral salts in the ordinary sense of the word, but acid salts in one way, and basic salts in another way—that is to say, they are salts which contain at the base, as well as at the acid, *hydroxyls*, which have not yet reached the formation of anhydride (neutralisation). The author gives instances of his mode of representing this matter, and states that he will shortly publish extensive researches on this subject.

On Betain, a New Vegetable Base met with in the Juice of Sugar Beet-Roots (*Beta vulgaris*).—M. C. Scheibler.—The author says, in the year 1866, he published a brief account about a vegetable base met with in the juice of the sugar beet-roots, and which base, on account of its great solubility, becomes accumulated during the sugar manufacture from beet-root juice, in the molasses which result from that process. The author has prepared this base from the freshly expressed juice of the sugar beet-root, as well as from the molasses. The process of separation is, as might be expected from the complex nature of the substances just named, very complicated, and requires the use of phosphomolybdate of soda. Since in this country there do not exist beet-root sugar works, and since large quantities of juice have to be operated upon, we do not enter into the details of preparation, but describe the now base *betain*. It is a solid substance, crystallising from its alcoholic solution in large crystals, which are very deliquescent, and contain water of crystallisation, which they lose by drying at 100° or over strong sulphuric acid; the base is very soluble in water, its solution saturated at 25°, has a specific gravity of 1·1177, and then contains 61·8 per cent of the anhydrous base. Betain does not affect vegetable colours, is void of smell, and has a sweetish cooling taste. The result of the elementary organic analysis of betain dried and fully deprived of all water led to the formula $C_5H_{11}NO_2$; the crystalline air-dried substance has the formula $C_5H_{11}NO_2 + H_2O$. This base yields, with many acids, beautifully crystallised salts, and readily forms well-crystallised double salts with the chlorides of gold and platinum, mercury, cadmium, and zinc. When betain is boiled with an aqueous solution of caustic potassa, it is thereby split up into several bases, among which trimethylamin is found. Oxidation of betain by means of chromic acid and the action of strong hydriodic acid, both tried in

sealed tubes, led to no results of any value. Betain resists the oxidising action of chromic acid.

Contribution to the Mode of the Analysis of the Gold and Platinum Salts of Organic Bases.—M. C. Scheibler.—The author dissolves a weighed quantity of the gold or platinum salt in water, or if it does not happen to be readily soluble therein, keeps it suspended therein, and places it in contract with metallic magnesium, whereby the metals gold and platinum are separated, and hydrogen is at the same time evolved. This operation is carried on at the ordinary temperature, or if the salts are difficultly soluble, on a water-bath; the fluid may be acidified, but not with hydrochloric acid, since the object often may be to estimate chlorine also. The ribbon-like magnesium wire met with in commerce is sufficiently pure for this purpose. The gold and platinum separated during this operation are, by means of careful decantation, freed from the fluid wherein they are immersed, and next transferred to a filter and washed, first with distilled water and next, after the filtrates intended for the estimation of chlorine have been set aside, with dilute hydrochloric acid, in order thereby to remove any excess of magnesium or any magnesia which might remain mixed with, or adhered to, these metals; after having been well purified and dried, the metals are ignited and weighed. The results obtained by this method are very correct.

Occurrence in the Molasses of Beet-Root Sugar of a New Acid Homologous with Asparaginic Acid.—M. C. Scheibler.—This is, as the author states, only a preliminary notice. He says some three years ago, he was occupied in experimenting on the preparation of asparagin, which, according to M. Rossignon's statement, is met with in freshly expressed sugar beet-root juice in quantities varying between 2 and 3 per cent. The author of this paper did not then discover asparagin, but instead thereof he found asparaginic acid; this acid, however, on more close examination, proved to be not the asparaginic acid itself, but an homologue thereof, to which, according to analysis, the formula $C_6H_9NO_4$ belongs. The author further states that he is not as yet enabled precisely to say whether the substance in question is really an homologue of asparaginic acid, or whether it is perhaps only a methylated asparaginic acid—

$$C_2H_3\left[\begin{matrix}CH_2\\H\end{matrix}\right\}N\Big]\Big\}_2O\ H_2$$

On a Di-carbonic Acid of Sulphur.—M. V. Meyer.—The author of this paper, after entering into some merely speculative discussion, states that he has succeeded in preparing dicarbonthionic ethyl ether, a colourless oily fluid, exhibiting a very characteristic but not very strong smell, boiling at 180°, but not entirely volatile without undergoing decomposition. The dicarbonthionic acid is unknown in free state; the researches on this subject are continued by the author.

Variable Vapour Densities.—M. Aug. Horstmann.—This paper will not admit of proper abstraction with due justice to the subject and the author, a remark which equally applies to the next paper.

Contribution to our Knowledge of Molecular Compounds.—M. Wichelhaus.

New and General Method for the Formation of Nitriles.—M. Henry.—The author of this paper communicates a series of experiments made by him with the view to prove "that the amides, when acted upon by pentasulphide of phosphorus, are readily converted into nitriles, while at the same time sulphuretted hydrogen and anhydrous phosphoric acid are formed." The author describes at great length his experiments with acetamide, benzamide, and oxamide, and in each case nitriles are formed with more or less readiness, and accompanied with a larger or smaller quantity of by-products.

On Parachlorotoluidine.—MM. Henry and Radziszewsky.—Parachlorotoluidine, $C_7H_6ClNH_2$, prepared by the authors by means of a rather complicated process from para-chloronitrotoluol, exhibits an oily strongly refractive liquid, the odour of which is akin to that of toluidine; its specific gravity at 18° is 1·175; boils at 236°; combines readily with hydrochloric, sulphuric, and nitric acids, forming therewith solid crystalline compounds. The authors state that this communication is only preliminary, and that their researches on this subject are not yet quite finished.

On Bismuth Silver.—M. Kayser.—When molten bismuth begins to solidify, the well-known phenomenon of the expulsion of a portion of the yet fluid metal from the interior of the partly fluid mass is observed in consequence of the fact that the solidified metal is specifically lighter than the molten and fluid metal; admixture of other metals, while impeding the crystallisation of the bismuth, also impede its expansion on cooling, but all metals do not act in this respect alike, for the addition of about 10 per cent of lead to bismuth entirely prevents its expansion. An alloy of silver and bismuth behaves in a different manner. The author, while working with silver on the large scale, accidentally obtained an alloy of the former metal and bismuth consisting, in 100 parts, of Bi, 56·1; Ag, 43·5. Upon the surface of this alloy were observed a large number of spherical particles of bismuth, measuring from 5 to 10 millimetres diameter, and consisting, in 100 parts, of Bi, 97·6; Ag, 2·355. While the operation of cupellation was being continued and the quantity of silver rose to 60, 70, and 80 per cent, the globules of bismuth expelled contained invariably 2·5 per cent of silver.

On Crystallised Phosphoric Acid.—M. Krämer.—When an aqueous solution of phosphoric acid, the specific gravity of which has been ascertained, and which solution consequently contains a known quantity of water, is so concentrated by evaporation that the remaining acid exactly corresponds to the formula H_3PO_4, this solution, on cooling, solidifies, yielding beautifully prismatic crystals of pure phosphoric acid.

On the Stilben Series.—MM. Limpricht and Schwaner state that the insinuation made against their researches on this subject, and especially the statement made by M. Grimaux, that his communication, on this subject made in 1867 in the *Bulletin de la Société Chimique de Paris*, has been made improper use of by the authors of the paper on the above subject, recently published in this German periodical, is altogether erroneous; they vindicate their rights and priority in this notice.

A Base Homologous with Kyanæthin.—M. Bayer.—In a rather lengthy paper, the author states that he has discovered a substance which he calls kyanæthin, consisting, in 100 parts, of—Carbon, 58·50; hydrogen, 7·35; nitrogen, 34·15; formula, $C_6H_9N_3$. This substance is a crystalline solid, readily soluble in water, less readily so in alcohol and ether, fuses at about 180°, sublimes without being decomposed, forming thereby finely white-coloured needle-shaped crystals; its vapour is very irritating and excites coughing; its taste is bitter and very like that of quinine. This base combines with acids, forming readily crystallisable salts. This base is a product, among others, of the action of sodium upon aceto-nitrile. The hydrochlorate of this base is composed according to the formula $C_6H_9N_3HCl$.

Cosmos, August 7, 1869.

This number contains, among a great mass of useful information not suitable for abstraction in our columns, a paper on the—

Ripening of Grapes by Cutting away part of the Leaves.—M. J. Comté.—At a meeting of the Agricultural Society of Agen, the author called attention to a chemico-physiological fact of great importance. It appears to have been an old custom, and [illegible]ines, especially in the Southe[illegible] of leaves, especially clo[illegible] stems, so as to allow fo[illegible] in consequ[illegible]

appear to be rather over-ripe. The author condemns this custom; and, while citing, among the older authorities on this subject, MM. Rosier and Chaptal, he states that, as regards the grapes, the presence of the leaves, as arranged by ature, is absolutely necessary to them for perfecting their maturity, which means for converting into grape sugar a portion of the acids present in the unripe grapes in large quantity. The carbonisation (by which word the author understands the addition of carbon to the acids) is effected by he leaves, through which the vegetable juice passes, for the urpose of becoming deoxidised. Fully ripe grapes should exhibit an agreeable green colour; grapes taken from the vine before they were ripe do not reach maturity at all, as other fruit does, but remain as they were. Taking away the leaves, therefore, does not ripen, or speed the ripening of the fruit, but only alters its colour to a shade of yellow, which enuinely ripe grown grapes never present. The taste of these yellow grapes is intensely sour, while that of the green-coloured ripe grapes is extremely sweet. The author regrets that the foolish practice alluded to is not authoritatively prohibited, on sanitary grounds, and for the reason that it is very injurious to the fruit-bearing of vineyards.

Levels of Two Seas.—M. Faye.—As a proof of the correctness of the geodesical survey made in 1798, during the celebrated Egyptian campaign, it may be stated that the author, on re-calculating the results then obtained for the difference in level between the Mediterranean and Red Seas, and comparing the results with those obtained when a survey for the construction of the Suez Canal was made in our time, found the results to be—0·85 metre for 1798, and 0·86 metre for 1866.

Influence of the Intensity of Coloured Light on the Quantity of Gas Set Free by Plants.—M. Prilleux.—It is well known that, under the influence of direct sunlight, the green-coloured parts of plants decompose carbonic acid. The author, in order to learn the effect of rays of light of equal intensity, has applied coloured solutions which could be rendered more or less deep coloured by adding thereto dye-stuffs, while the intensity of the light was photometrically measured. In the midst of these coloured aqueous solutions, branches of aquatic plants were placed in large glasses filled with water saturated with carbonic acid. The undermentioned figures denote the activity of decomposition of carbonic acid for two kinds of aquatic plants thus exposed during one minute of time. No. 1 refers to the *Potamogeton perfoliatus*, Nos. 2 and 3 to *Elodea canadensis*.

White light.....	64·75	74·5	51·36
Blue light.....	56·00	58·8	52·92
Orange light.....	55·30	57·0	38·00

There may, therefore, be deduced from these experiments that the differently coloured lights do also act differently upon the green parts of plants, and call forth an equal disengagement of oxygen, when the intensity of the light remains the same, and, consequently, all the rays of the solar spectrum cause the decomposition of carbonic acid by plants.

August 14, 1869.

For those interested in very speculative matters, we mention that this number contains, as did a preceding, and as will, in all probability, one or more of the next numbers, an article on the—

Means of Communication between our Earth and the Planets.—M. C. Cros.—We do not enter into the details, as they do not belong to the domain of chemistry or the sciences more immediately connected therewith.

Les Mondes, August 5, 1869.

We quote from this paper the following:—

Chemical Laboratory at Neufchatel.—This well-known, beautifully-situated little Swiss town, with a population of about 11,000, has obtained an excellently well-arranged chemical laboratory, placed under the direction of Dr. Sacc. There is ample room provided for forty students to work comfortably, and provided with all useful instruments. The building contains lecture-rooms, and every other requisite. The town possesses excellent educational establishments, and is a very healthy place.

Manufacture of Various Objects from Quills.—M. Clerget.—While the southern parts of France, only a few hundred miles distant by rail from Paris, could throw into the trade large quantities of excellent material (home produced), the cost of transport by rail from Toulouse to Paris, for the same weight and bulk, is only two francs less than the enormously long and circuitous journey from Kasan and Nijni-Novgorod to Paris. The article in question, not being one subject to deterioration, requires, of course, no great speed in conveyance. The quills and feathers are sorted; the smallest are used for ornamenting toys, while the better quills are turned into tooth-picks, and nibs for writing purposes, and almost all the rest, except the pith, is used in ornamental-flower making, brush-making, and imitation of horse-hair work. The feathers have recently been woven into a tissue fit for use as carpets, by means of machinery invented by M. Bardin, the owner of the works inspected by the above-named gentleman officially, to see that all hygienic measures are duly carried out.

Researches on the Illumination of Liquids by means of a Beam of Neutral or Polarised Light.—M. Lallemand.—The author describes minutely in this paper a series of minute optical experiments with liquids suitably held in tubes. When a beam of sunlight is made to illuminate different liquids, there are observed various phenomena dependent upon the substance employed, or under observation. In this aspect, liquids are divided into three categories—(1) some do not possess any perceptible fluorescence, and are devoid of rotatory power; (2) they possess more or less fluorescence, and, akin to the first, are devoid of all rotatory power; (3) these fluids have rotatory power, and exhibit, in addition thereto, often a very strong fluorescence. To the first class belong, among other liquids, water, nitric and hydrochloric acids, and liquid ammonia. Samples of second class—Solutions in pure water of salts of quinine, also esculine, and, among pure liquids, perfectly chemically-pure sulphide of carbon. Third class—A concentrated solution of pure cane-sugar may serve as examples.

Comptes Rendus des Séances de l'Académie des Sciences, August 23, 1869.

This number contains the following memoirs and communications bearing more especially upon chemistry:—

Researches on the Ethereal Derivatives from Propylic Alcohol.—MM. Pierre and Puchot.—Iodide of propyl, prepared by the reaction of phosphorus upon a mixture of pure propylic alcohol and iodine, exhibits, after repeated purification, a colourless liquid, having a sweetish, somewhat alliaceous odour, boiling at 104·5°; sp. gr., 1·784 at 0°. When this fluid is exposed to air, it is slowly decomposed, and iodine is set free.—Valerianate of propyl, prepared by distilling a mixture of pure propylic alcohol, pure valerianate of potassa, previously dried, and sulphuric acid, very cautiously and gradually added to the mixture, is, after having been purified, a colourless liquid, boiling at 157°; sp. gr. at 0°, 0·887.—Butyrate of propyl, $C_8H_7O_2$, C_6H_7O, is obtained by the very cautious distillation of a mixture of previously-dried butyrate of potassa, propylic alcohol, and sulphuric acid. After repeated rectification, a fluid is obtained which boils at 137·25°, is colourless, and exhales the odour of fruit and herb of mint, mixed; sp. gr. at 0°, 0·888.—Acetate of propyl, $C_4H_3O_3,C_6H_7O$, is prepared by distilling a mixture of propylic alcohol, dried acetate of soda, and sulphuric acid. After repeated rectifications, a very limpid, colourless, agreeably-smelling liquid is obtained, boiling at 103°. Sp. gr. at 0°, 0·910.—Formiate of propyl, C_2HO_2,C_6H_7O. After rectification, a liquid is obtained

boiling at about 83°. Sp. gr. at 0°, 0·9197.—Propionate of butyl, $C_6H_5O_3,C_8H_9O$, is obtained by distilling a mixture of previously-dried propionate of potassa, butylic alcohol, and sulphuric acid, after repeated distillation and rectification of the raw liquid first obtained. The pure ether is a very fluid, colourless, agreeably-smelling liquid, boiling at 135·7°. Sp. gr. at 0°, 0·8934.—Propionate of ethyl, $C_6H_5O_3,C_4H_5O$, obtained by distilling a mixture of previously-dried propionate of potassa, pure strong alcohol (95 per cent), and sulphuric acid. The purified liquid boils at 100°; its odour is somewhat akin to that of acetic ether. Sp. gr. at 0°, 0·9137.

The Metrical System.—M. J. Dumas.—The report of the committee on this subject, of which this eminent *savant* is the spokesman, reviews the labours of a very select committee of eminent men, representing not only France, but also Switzerland and Holland, who commenced their work in the year 1790, and finished it on the 4th of Messidor, of the year VII. (23rd of June, A.D. 1800). The present committee recommends that the standards of weights and measures in the custody of the Academy shall on no account whatever be altered or tampered with in any way. Since these standards have been made and verified by an international committee of *savants*, and every care was taken to ensure the perfection of these standards, the committee also recommend that the French government shall give permission to delegates of foreign nations to get copies made of the standards alluded to under proper supervision, and that these delegates do take what care they deem proper to ensure correctness of these copies.

Manufacture of Special Kinds of Pig-Iron.—M. Jordan.—This is a metallurgical memoir, wherein the author discusses the calorific phenomena produced by the injection of jets of air, steam, or oxygen into molten cast-iron. The tendency of this paper is entirely practical, and it is, moreover, too lengthy for useful abstraction.

Chloride of Acetylen and the Synthesis of Julin's Chloride.—MM. Berthelot and Jungfleisch.—Instead of making chlorine in free state act upon acetylen, the authors have applied chloride of antimony, by which acetylen is rapidly absorbed, so much so, that, owing to the strong heat which is developed, the mixture has to be cooled. A compound of equal equivalents of perchloride of antimony and of acetylen is obtained, $C_4H_2SbCl_5$. This body is instantaneously decomposed by water; and when gently heated, it is split up into protochloride of acetylen and protochloride of antimony—

$$C_4H_2.SbCl_5=C_4H_2Cl_2+SbCl_3.$$

The protochloride of acetylen is a colourless liquid; it smells like chloroform; boils at 55°; moist air slowly decomposes it; heated in sealed tubes to 360°, it is decomposed, carbon deposited, and hydrochloric acid formed. Perchloride of acetylen, $C_4H_2Cl_4$, is also a liquid, boiling at 147°. When this substance is poured into a bottle filled with chlorine gas, it is converted into sesquichloride of carbon, C_4Cl_6; heated to 300° in a sealed tube during fifteen hours, this perchloride is converted into chlorinated protochloride of acetylen and hydrochloric acid—

$$C_4H_2Cl_4=C_4HCl.Cl_2+HCl.$$

When the temperature is raised to 360°, and continued for 100 hours, the perchloride of acetylen is converted into the so-called chloride of Julin, which is identical with perchlorinated benzine, and hydrochloric acid—

$$3C_4H_2Cl_4=C_{12}Cl_6+6HCl.$$

Les Mondes, August 12, 1869.

From this number we abstract:—

Electric Light.—The editor learns, with great pleasure, that the directors of the Transatlantic French Steam Navigation Company have entered into a contract for supplying, to their vessels, magneto-electric machines and other requisite apparatus for exhibiting on board during the night-time electric lights as signal-lamps. The superiority of the light is manifest. It need hardly be pointed out that, by adopting this mode of illumination, the directors of the aforesaid Steam Navigation Company greatly increase the safety of their vessels. Electric light ought to be more generally used for this purpose.

New Mode of Gas-Lighting.—M. Boital.—Although no particulars are as yet given, it appears, from a short notice in this paper, that the party just named has established a gaswork, capable of supplying 600 burners on a square surface of no more than 12 square metres. The gas produced is of excellent quality, and the price of making the requisite works, as well as the gas produced, is very low.

This number contains a lengthy paper, illustrated with woodcuts, on the—

Manufacture of Soda-Water-Making Machines and other Machinery.—We only name the title; parties interested will do well to consult the original, which is full of excellent and useful information on this matter.

Journal fur Praktische Chemie, No. 10, 1869.

This number contains the following original essays and papers:—

Experiments on the Salts of the Cerium Bases.—M. H. Zschiesche.—The author of this essay treats, under separate headings:—1st. *Lanthanum Compounds.*—The oxide of lanthanum was obtained by strong and long-continued heating of the oxalate of that base. So obtained, it constitutes a pale red powder, which readily attracts carbonic acid from the air, thereby changing into a bright white-coloured carbonate of lanthanum. The oxide is readily soluble in acids, yielding therewith absolutely colourless salts. Oxalic acid, or better still, oxalate of ammonia, precipitates oxalate of oxide of lanthanum from its neutral or slightly acid solutions, but an addition of ammonia is required for complete precipitation. The oxide of lanthanum is readily soluble in hydrochloric acid, yielding therewith chloride of lanthanum; the neutral chloride crystallises in large non-deliquescent crystals containing five atoms of water. 2nd. *Didymium Compounds.*—The oxide was obtained, as that of lanthanum, by a long-continued and strong ignition of the oxalate; the colour of the oxide so obtained is bright ash-grey. The sulphate of the oxide of didymium is obtained by dissolving the ignited oxalate in sulphuric acid; the excess of that acid is removed by evaporation, the saline mass dissolved in water: and, after concentration of the solution on a water-bath, crystals are obtained exhibiting the colour often exhibited by sulphate of manganese. The author applied this salt to the estimation of the atomic weight of the oxide of didymium, which he found equal to 54·585. Chloride of didymium crystallises with some difficulty, owing to the fact that this salt is very deliquescent; dried over sulphuric acid, the composition of this salt is DiCl+5HO. The nitrate of oxide of didymium also crystallises, but the substance is equally deliquescent as the previously-mentioned salt. 3rd. *Compounds of Cerium.*—If we except, says the author, the combinations of oxydulo-oxide of cerium, the compounds of this element have been frequently the subject of researches. When perfectly pure oxalate of cerium is strongly ignited, there ensues a compound corresponding to the formula Ce_2O_4. When this compound is treated with strong sulphuric acid, it evolves a great deal of heat, and forms, when brought into contact with water, a deep orange-coloured solution, which, on evaporation, yields beautiful crystals, in appearance like those of bichromate of potassa;

The mothe

coloured salt, of which the following formula exhibits the composition:—

$$CeOSO_3 + Ce_2O_3SO_3 + 8HO.$$

The author, after passing a review of several compounds of cerium, treats, at very great length, of various double salts of the cerium bases, but his essay is too lengthy, on the one hand, and too full of formulæ on the other, to yield scope for further useful abstraction.

Action of Hypochlorous Acid upon a Mixture of Iodine and Anhydrous Acetic Acid.—M. Schützenberger.—The substance which is the result of the action just alluded to is, when pure, a solid crystalline body, which, according to the results of analysis, has the formula $[(C_2H_3O_3)_2Cl]$. The author found that this substance, when dissolved in anhydrous acetic acid, acts, at the ordinary temperature, upon metals (copper, for instance), yielding acetic acid and the iodide of the metal; zinc ethyl violently yielding acetate of zinc, acetate of ethyl ether, and iodide of ethyl. The substance does not act upon dry benzol at the ordinary temperature; but if the mixture is heated up to the boiling point of the benzol, the compound of iodine and anhydrous acetic acid dissolves therein, and deposits again from it on cooling.

Quantitative Estimation of Copper by Sulphuretted Hydrogen.—M. E. Ulrici.—The main results of the author's researches may be briefly summarised thus:—1st. When the precipitate occasioned, in solutions of copper, by sulphuretted hydrogen, is submitted to strong ignition in an open or covered porcelain crucible, the residue of this ignition is almost always a compound exactly corresponding, by calculation, to the formula Cu_2S. 2nd. This residue is always a mixture of Cu_2S and CuO. 3rd. The result of ignition in a closed porcelain crucible, the lid of which is only now and then removed, will yield a chocolate brown-coloured compound, agreeing with the formula $Cu_2S + CuO$. The author states that a series of experiments has convinced him that the precipitate obtained by HS from copper solutions may advantageously be applied, after having been well washed, dried, and ignited, for the quantitative estimation of copper. There is added to this paper a lengthy tabulated form, exhibiting results obtained, which certainly indicate that, with due care, this new method of quantitative estimation may often be advantageously applied.

Tyrosin.—M. Barth.—The author states that the results of a series of researches on this subject led him to the conclusion that tyrosin has to be considered as an oxyphenylamidpropionic acid. The author is engaged with experiments to prove this synthetically.

NOTES AND QUERIES.

Vacuol.—I have met frequently in recent Continental journals with the terms "vacuol" and "vacuolised," in reference to fungi or the cells of fungi. I cannot find these words in Watts's "Dictionary," or in any of the foreign scientific dictionaries. Can any of your readers tell me the meaning of these terms, and with whom they originated?—CARBON.

Wood-Lice.—I should be very much obliged if any of your correspondents can inform me how to destroy wood-lice in beams, floors, and furniture. It should be something that would not injure or discolour the furniture.—WOOD PRESERVER.

Dr. Gladstone's Experiments on Light.—Seeing in your report of Dr. Gladstone's Friday evening lecture at the Royal Institution, delivered April 24, 1868, and contained in your impression of June 5, 1868 (*Am. Repr., Aug.*, '68, *page* 93), that he has discovered that, in the case of liquids, $\frac{\mu-1}{d}$ is constant for all temperatures and for all mixtures, with some slight deviations, owing, apparently, to an undiscovered law, you will confer a great favour on me if you will give me the number.—ALPH.

[Dr. Gladstone informs us that the fact that, in the case of liquids, $\frac{\mu-1}{d}$ is a constant for all temperatures and for mixtures, with some slight deviation, was discovered by Mr. Dale and himself several years ago, and has been verified by some of the German physicists. They (Dr. Gladstone and Mr. Dale) have, however, gone far beyond that now, showing that it is a constant (generally speaking) notwithstanding chemical combination. Dr. Gladstone sent a long paper founded on this to the Royal Society last month.—*Ed.* C. N.]

Drying of Animal and Vegetable Substances.—Dr. Müller.—A large glass vessel, a tumbler for instance, is filled for about half its capacity with fused chloride of calcium, and over this a quantity of ether is poured; on the top of the glass vessel another suitable glass or porcelain vessel is placed containing the substance to be dried, and over these vessels, previously placed on a polished glass plate, a bell-jar is placed. The drying takes place in consequence of the fact that the chloride of calcium withdraws water continuously from the ether, and the vapour of the latter, in its turn, withdraws the water from the substances to be dried. It is stated that both animal and vegetable substances dried by this process retain their natural colour, and that animal substances, moreover, retain their elasticity and flexibility.—*Deutsche Ind. Zeitung.*

Yeast.—The essential cause of the difference of beer-yeast and the so-called German yeast, is due—1st, to the materials submitted to fermentation; 2nd, to the mode of conducting that process. The so-called German yeast is chiefly made at Schiedam, and owes its origin and qualities to the large quantity of raw (that is to say, unmalted) grain, chiefly rye, used for making Hollands. More correctly speaking, the starch of the grain, after having been converted into sugar by the aid of a comparatively small quantity of barley-malt, is suffered to undergo alcoholic fermentation. This fermentation proceeds far more slowly than the fermentation of the wort of malt intended for beer; and it is the slowness of this process, the use of raw grain, and the peculiar mode of setting up the fermentation, which constitute the essential difference of the yeast. After it leaves the distilleries, the yeast is carefully washed with very cold and pure water, and often, though not always, mixed with some very finely-ground starch; and, next, strongly pressed into stout canvas bags, and sent off to Paris, Berlin, Vienna, and elsewhere. If beer-yeast were washed, it would, perhaps, keep a longer time, but never so long as the yeast just alluded to, owing to the fact that the formation of beer-yeast takes place more tumultuously. German yeast has been made perfectly dry over sulphuric acid *in vacuo*, and in that state it may be kept, in well-closed bottles or tin canisters, in a dry and cool place, for any length of time, and has been sent, in good condition, even to Batavia and Calcutta.

Wood Lice.—Oil of turpentine, or, better yet, carbolic acid, especially if care be taken that the latter be pure and colourless, will destroy these insects, without injury to wood-work or furniture, which should be painted over, as it were, with these fluids. If, however, the smell of these substances be objected to, a solution of corrosive sublimate in water, with the addition of some common salt to increase its solubility, may be applied; but this solution is highly poisonous to men and animals.

Estimation of Phosphates in Manures.—A very valuable communication appeared in the CHEMICAL NEWS, vol. xx., p. 77 (*Am. Repr., Oct.*, '69, *page* 212), on the "Estimation of Phosphates in Manures." Will Mr. Sutton, or any of your other correspondents, inform me if it is possible for a superphosphate to go back or lose any portion of its soluble phosphate and at the same time contain an excess of sulphuric acid? which I believe all commercial superphosphates do in a certain degree.—FARMER.

Aniline Colours.—Can any of your correspondents kindly favour me with the best and cheapest method of dissolving aniline colours suitable for calico-printers?—ALEXIS.

Tungstate of Soda.—Can you tell me if tungstate of soda is a conductor or non-conductor of heat, and where I can get it, and price? I want it to make paper fireproof, or can you tell me of anything else that will make paper fireproof, and at the same time a non-conductor of heat, and cheap?—ALFRED BURN.

Printing Scarlet.—Can any of your courteous readers inform me of a substance that will prevent a solution of bichloride of mercury from being decomposed when boiled in a copper kettle, but afterwards permit it to be precipitated as a scarlet biniodide by a solution of iodide of potassium? I wish to print it upon cotton-cloth, using the same *modus operandi* as calico-printing. I find that the copper colour-kettles and printing-rollers decompose it, in consequence of the mercury uniting with the copper. The effect is not satisfactory if I use the solution of iodide of potassium as a mordant. How can I prevent the chloride solution from being decomposed?—WILLIAN.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS *give notice that in accordance with a suggestion of* MR. CROOKES, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* MR. CROOKES *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Books Received.—"Recent Discussions on the Abolition of Patents for Inventions in the United Kingdom, France, Germany, and the Netherlands." London: Longmans, Green and Co. "Chemical Manufacturers' Plant," by Robert Daglish and Co. Lancashire: St. Helen's Foundry. "On Fresh Meat Preservation," by J. [illegible] Gamgee. London: Robert Hardwicke.

[*English Edition, Vol. XX., No.* 510, page 118; No. 506, page 72; No. 507, page 84; No. 508, page 96; No. 509, page 108; No. 510, page 120.]

AMERICAN SUPPLEMENT.

New York, October, 1869.

The "Ellershausen" Process for Producing Wrought-Iron.

BY H. ENDEMANN, PH.D.

FROM a book upon the use of gas as fuel in metallurgical and other technical operations, translated from the German, and enlarged by G. T. Coursen, E.M., and the present writer, the following summary of the process, which heads this article, is placed before the readers of this journal.

This process is an American invention, and has excited much interest among the iron-masters of this country. It is based upon the discovery that cast-iron, thoroughly intermingled with oxides of iron, will not melt, and that the products of oxidation by heat can be removed by simple mechanical operations.

The Apparatus.—The machinery, used in mixing the cast-iron and iron ore, consists of a cast-iron turn-table, twelve to fourteen feet in diameter, carrying a trough two feet wide by one foot deep, the outer wall of the trough being attached to the circumference of the table, thus forming a circular trough. The trough is divided into compartments, by vertical cast-iron plates, and the outer wall consists of plates which can be easily detached from the table.

The turn-table revolves upon cog-wheels, being moved by a small engine of five-horse power.

A cast-iron trough connects the tap-hole of the blast-furnace with a stationary receiver, situated upon a line with the circumference of the turn-table and above it.

The receiver has a delivery spout of the same width as the circular trough upon the table. The pulverized iron ore used in making the mixture flows from the bins down an inclined spout to the turn-table, the end of the spout being in close proximity to the end of the delivery spout of the cast-iron receiver, before mentioned.

The Process.—The molten cast-iron flows from the blast-furnace into the receiver, and falls in a thin sheet from the delivery spout into the circular trough, upon the turn-table, meeting, in its descent, the current of iron ore flowing from the opposite direction.

The quantity of ore used varies from 30 to 40 per cent of the cast-iron. The turn-table revolves at a rate of 225 to 250 feet per minute; the trough is thus gradually filled with layers of the mixture; and the outer casing of the trough being removed, the cakes of pig-bloom are detached from the trough. These cakes weigh from 100 to 150 lbs. each, according to the length of the compartments.

The conversion of the cast-iron into wrought-iron, partially effected in the mixing process, is completed by reheating and forging.

Chemistry of the Process.—In the common puddling process, the chemical action of the oxygen of air upon the iron is very slow, as it depends upon exposing the surface of the iron to its action. In the "Ellershausen" process we have the oxygen in a compact form, and are able to mix it at once thoroughly with the iron; so that we reach, with one simple and short heating process, what was accomplished in the old method by a laborious process and great loss. The oxygen of the iron ore combines with the impurities of the cast-iron, and a certain amount of iron being thus freed from the ore, increases the amount of muck-bar produced. The oxidized impurities, as the sulphur and carbon, are partially removed during the mixing process, in the form of sulphurous acid and carbonic oxide; while the remainder, together with the excess of ore, is eliminated by the reheating and forging process.

The oxygen, in the ore used, is more than sufficient to oxidize the impurities of the iron; but experience has proved that the proportion of ore cannot be diminished with safety, by reason of the difficulty of obtaining a thorough mixture. To utilize the surplus of ore, some experiments have been made by mixing a certain quantity of carbon, anthracite, charcoal, or coke dust, with the ore, which reduces part of the iron ore, and increases the product, without interfering with the oxidation of the impurities. These experiments have been attended with some success.

The question, whether the product is as pure as that produced by the old process, is settled by the following analyses made by Otto Wuth, of Pittsburg, Pa., and kindly placed at our disposal by Mr. James P. Speer, of Pittsburg, Pa.

The ores, used for mixing at the works of Messrs. Shoenberger & Co., of Pittsburg, are magnetic ores, of 65 per cent of iron, with no sulphur and traces of phosphorus; and Iron Mountain red hematite of the same percentage.

The ore used by Lyon, Shorb & Co., is brown hematite, containing 53 per cent of iron, 0.21 per cent phosphoric acid, 13 per cent. water, the balance being silica and alumina.

(*a*) Pig metal from Shoenberger & Co.; coke metal smelted from Lake Superior, with a small quantity of Sterling and Marmora ores.

(*b*) Puddled iron from (*a*).

(*c*) Wrought iron from (*a*) by the Ellershausen process:

	(*a*)	(*b*.)	(*c*)
Carbon (chem. comb.)	2·87	0·43	0·39
Graphite	1·34		
Silicon	1·02	0·20	0·09
Sulphur	0·14	0·11	0·006
Phosphorus	0·58	0·12	0·14
Iron	92·46		
Other substances not determined.			

(*i*) Puddled slag from (*b*.)

(*k*) Slag from (*c*).

	(*i*)	(*k*)
Silicic acid	14·02	8·95
Peroxide of iron	17·71	16·01
Protoxide of iron	60·31	68·88
Lime	2·08	1·74
Magnesia	0·84	0·85
Alumina	1·44	1·31
Phosphoric acid	2·54	1·74
Sulphide of iron (?)	0·88	0·72

The sample (*b*) was puddled with old cinder from the puddling furnace, so that some of the resulting slag was due to this fact; while in (*c*) nothing but the iron and ore was used. The larger amounts of phosphoric acid and sulphur in (*i*) than in (*k*) may therefore have been derived from this old cinder rather than from the iron.

A pig-metal smelted at the same works from Marmora ore containing much sulphur, contained—

Sulphur	0.42

The wrought-iron from the same contained, when puddled,

Sulphur..... 0.027

When worked by the Ellershausen process,

Sulphur..... 0.012

(*d*) Pig-metal from Sligo furnace, Lyon, Shorb & Co.
(*e*) Wrought-iron puddled from (*d*).
(*f*) Wrought-iron from (*d*), Ellershausen process:
(*g*) " " " " "
(*h*) " " " " "

	(*d*)	(*e*)	(*f*)	(*g*)	(*h*)
Carbon (combined)	1.05	0.34	0.29	0.31	0.24
Graphite.....	3.86				
Silicon.....	0.93	0.17	0.16	0.07	0.05
Sulphur.....	0.03	trace	trace	trace	trace
Phosphorus.....	0.57	0.25	0.22	0.16	0.15
Iron.....	93.01				
Manganese.....	0.21				
Slag and traces of cobalt and calcium	0.34				

Importance of the Spectroscope in Mineral Water Analyses.

Owing to the recent discovery of the remarkable and valuable Lithia waters at Saratoga and Ballston, which also contain both baryta and strontia, it may be interesting to notice the importance of the spectroscope in enabling the chemist to ascertain with certainty the completeness of the separation and the accuracy of the estimation of these substances in mineral water analyses.

Lithia is generally present in mineral waters as a carbonate, and may be often separated, together with the chlorides, bromides, and iodides of the alkalies, by repeated treatment of the residue obtained by evaporation of such a water to dryness, with boiling water.

If the amount of lithia present is not too great, its separation by boiling water from all the bases, save the alkalies, is readily accomplished; but, if the amount be as great as in some of the Ballston and Saratoga waters, the separation is by no means easy. The only positive proof of the completeness of the separation, in such cases, is obtained by the aid of the spectroscope, it being impossible to detect small quantities of lithia, especially when associated with so much soda and lime, by any ordinary qualitative tests. By the use of the spectroscope, the analyst is enabled to ascertain the accuracy of the separation with ease and certainty. From time to time minute assays of the residue are examined by the spectroscope, and the lithia line is observed to grow fainter and fainter, until, at last, it is no longer discernible.

The water solution, thus obtained, is evaporated to dryness, and the saline residue, after being moistened with hydrochloric acid, and again carefully evaporated to dryness, repeatedly digested with absolute alcohol, until it ceases to give a lithia reaction with the spectroscope.

The alcoholic solution obtained by this treatment is evaporated to remove the alcohol, the residue dissolved in water, and the lithia separated in the usual manner with phosphate of soda, the purity of the phosphate of lithia obtained being tested by the spectroscope.

In mineral waters, containing a large amount of lithia, it is sometimes impossible to entirely separate it from the residues obtained by evaporation, even by a very prolonged treatment with boiling water. After the constant treatment of such a residue for several days with boiling water, it still gave a characteristic spectroscopic reaction for lithia. In such cases the residue is dissolved in hydrochloric acid; the solution evaporated to dryness in order to remove silicic acid; iron and alumina removed, from the filtrate from the silicic acid, by ammonia; lime, baryta and strontia by carbonate of ammonia, and magnesia by hydrate of lime. In the separation of lithia by this process, the spectroscope is of great importance, inasmuch as the various precipitates are readily and surely tested by its use, and the washing of them all is to be continued until the lithia reaction ceases to appear.

In the analysis of mineral waters containing baryta and strontia, the certainty of accuracy in the separation of these bases from lime and from each other is much increased if the analysis be controlled by the use of the spectroscope. In case the mixed sulphates of lime, baryta, and strontia have been obtained in the course of analysis, and the strontia and lime are to be removed by digestion with carbonate of ammonia, the purity of the remaining sulphate of baryta can only be readily ascertained by means of the spectroscope. So, too, in the separation of strontia from lime by treatment of the nitrates with a mixture of alcohol and ether, the insoluble nitrate of strontia may retain lime, which, if not detected by the spectroscope, would probably figure in the analyst's report as strontia.

Edward W. Root.

The American Association for the Advancement of Science.

After a session of seven days, duration, the Association adjourned, August 25th, to meet in Troy, August 7, 1870. The Society had its origin, in 1840, in Philadelphia, under the title of "The Association of American Geologists." At the meeting held in Boston, in 1842, the scope of the Society was widened, and the title of "The Association of American Geologists and Naturalists was adopted." In 1847 the present name was assumed by the Association.

Great interest was manifested in the meeting this year, 250 members attending, and 160 papers being presented. Two new subsections were organized, one embracing Ethnography and Anthropology, and the other Microscopy.

The officers elected for the meeting of 1870 are as follows:

President, Prof. William Chauvenet, of St. Louis.

Vice-President, Prof. T. Sterry Hunt, of Montreal.

Permanent Secretary, Prof. Joseph Lovering, of Cambridge.

General Secretary, Prof. Charles F. Hartt, of Ithaca, N. Y.

Treasurer, Dr. A. L. Elwyn, Philadelphia.

Standing Committee.—Samuel Felton, Philadelphia; M. D. Hanover, Cincinnati; L. H. Morgan, Rochester, N. Y.; Col. J. W. Foster, Chicago; J. D. Warner, Brooklyn, N. Y.; W. B. Ogden, N. Y.; J. H. Devereux, Cleveland; Dr. G. B. Lewis, Salem, Mass.

But few of the papers presented this year related strictly to chemistry. Some of the physical papers were of special interest to chemists.

Prof. Van der Weyde read a paper on the determination of the mechanical equivalent of heat by means of the modern ice and cooling machines; he referred to the great loss of power in transforming heat into motion, while in the reverse process the full equivalent is

obtained, namely, 770 foot-pounds for every unit of heat. He showed that in producing cold (negative heat) the full equivalent was obtained, as the result of actual experiment. Prof. Van der Weyde made the interesting statement, that with one of the ordinary machines one ton of coal produces cold equal to the consumption of fourteen tons of ice.

Prof H. Wurtz read a paper on the Grahamite of West Virginia; he considers it inspissated petroleum, and not to be classed with coal, Albertite, or asphaltum. It is almost wholly dissolved by bisulphide of carbon and by chloroform, forming a dark brown liquid. This contains two substances, *viscosine* and *iriscine*, which are separated by means of sulphuric acid. *Viscosine* is a viscous hydrocarbon, insoluble in most menstrua. When a solution of *iriscine* is allowed to evaporate in a thin layer, a beautiful iridescence is developed, which appears to be a characteristic reaction, and suggested the name of *iriscine*. Grahamite has been recently discovered in Colorado, resembling the Virginia mineral in every respect.

Mr. W. R. Nichols presented a paper giving the results of analyses of the oxalates of the alkalies. He confirmed Rammelsberg's formula for the binoxalate of potassium $4(C_2 K HO_4) + aq.$, and found that of the ammonia salt to be $2(C_2 (NH_4) HO_4) + aq.$, and not $C_2 (NH_4) HO_4 + aq.$, as generally given. Mr. Nichols also gave a table of the solubility of various oxalates, the estimations being made by titrition, with permanganate of potash.

Prof. Seely gave his views with regard to the classification of the elements, which have been fully set forth in previous numbers of the CHEMICAL NEWS. He also presented his new method for the estimation of carbonic acid.

Prof. Gustavus Hinrichs also read an article on the Classification of the Elements, based on the mobility of the particles of the different elements, as expressed in their volatility and fusibility. He made use of a series of charts, of which it is difficult, within the limits of this abstract, to convey an understanding. Prof. Hinrichs further called attention to the variations between Stas' figures and whole numbers in his determinations of the atomic weights. He showed that in certain groups the fractions were all plus, and in others minus, and they increase with the atomic weight of the element, thus:

Li	7	+ 0·022
Na	23	+ 0·043
K	39	+ 0·137
Cl	35·5	− 0·025
Br	80	− 0·048
I.	127	− 0·150

These variations he calls perturbations, the cause of which remains to be explained; he considers Stas' determinations the very best support of Prout's theory.

Prof. Horsford announced the discovery of phosphoric acid, iron, and potassium as constituents of chlorophyll. He also gave some newly discovered properties of phosphoric acid.

T. Sterry Hunt read some notes upon the chemistry of copper, and Profs. Silliman and Wurtz presented a paper upon flame temperatures in their relations to compositions and luminosity. Prof. Silliman also read a paper on the relation between the intensity of light produced by the combustion of illuminating gas and the volume of the gas consumed. He approved Farmer's theorem, that the intensity of gas flames (*i. e.*, their illuminating power) increases, within ordinary limits of consumption, as the square of the volume of gas consumed. In variations from the standard of consumption of five cubic feet of gas, and one hundred and twenty grains of sperm candle, the observed data are computed up or down by the rule of three. Governed by this rule, a gas, burning three and a half feet per hour, gave 28·57 candles as its value. But calculated by Farmer's rule, 40 candle power was the result. Prof. Silliman gave results of experiments made by him to prove Farmer's rule to be correct.

The National Academy of Science.

THE annual meeting of this body occurred at Northampton, Mass., September 1st and 2d, and adjourned to meet on the 3d Tuesday of April, 1870, in Washington. The papers presented were highly interesting. We have space merely for the titles.

Arrangement of Volcanoes on the Earth, and their Influence on our Globe. By Prof. Guyot.

On the Rocky Mountains. By Prof. Hall. On the Rotation of the Earth. By General Barnard. Dr. Wolcott Gibbs read a short paper upon a special formula in chemistry; Dr. Gould and Dr. L. Alexander, interesting papers upon the eclipse; Captain John Ericsson presented a paper on the Retardation of the Earth's Rotation by Solar Influence; Prof. Henry, On Subjective Colors and their Application to Solar Eclipses; Prof. Silliman read a paper by Prof. A. C. Twining, on the recent eclipse; Prof. Barker one on salt, by Prof. C. A. Goessmann; and Prof. Gibbs one on the Aurora Borealis, by W. H. Dall.

American Pharmaceutical Association.

THE seventeenth annual session of this Association commenced September 7th, in Chicago.

In connection with the meeting, an exhibition of chemicals and apparatus was held in an adjoining hall. All the principal manufacturers were represented. A microscopical exhibition at the Academy of Sciences also added to the interest of the occasion. The papers presented were of a highly interesting character. A series of resolutions was passed, recommending the passage of a law, by the legislatures of the several States, regulating the practice of pharmacy, and requiring a proper degree of qualification and education in persons engaging in the practice of pharmacy.

The next meeting will be held in Baltimore the second Tuesday in September, 1870.

Dangerous Kerosene.

ACCORDING to the Fire Marshal's report, there were sixty-four fires in New York during the month of August, and of this number seven were caused by *kerosene*. Deaths by explosions are frequent. Out of over a hundred samples of oil tested in the laboratory of the Board of Health, only one attained the requirements of the law. In several instances naphtha was sold as a "*safety oil*."

Not only do the manufacturers sell oil below the standard, but the retailers adulterate this with naphtha.

The legislature should enact a law making this a crime as great as that of arson. In the meantime, the Board of Health should continue to test the oils sold, and to publish the names of the dealers, and bring them to justice. By such agitation the public will be brought to a proper understanding of the danger.

Recent Chemical Patents.

Issued August 24, 1869.

93,952.—Apparatus for Removing Benzine from Hydrocarbons. H. J. Berg, Butler, Pa.

93,972.—Cooling Soap, and Forming the same into Bars. S. R. Divine, New York.

93,988.—Manufacture of Rosin and Spirits of Turpentine. J. F. Griffen, New York.

94,008.—Apparatus for Clarifying Cane-Juice by Means of Sulphurous Acid Gas. A. Labauve, Convent, La.

94,073.—Manufacture of Soap. W. T. Bush, Obion county, Tenn.

94,079.—Composition for Gumming Postage and Revenue Stamps. C. L. Coombs, Washington, D. C.

94,080.—Composition of Matter for Various Uses in the Arts. C. L. Coombs, Washington, D. C.

94,084.—Composition for Covering Steam Boilers, Pipes, and other Articles. W. B. Davis, Brooklyn, N. Y.

94,131.—Manufacture of Paper. J. B. Read, Tuscaloosa, Ala.

94,157.—Generating Gas for Motive Power, for Extinguishing Fires, and for other purposes. C. G. Wheeler, Chicago, Ill.

Issued August 31, 1869.

94,204.—Method of Seasoning and Preserving Wood. T. W. Heinemann, New York.

94,214.—Manufacture of Carbonate of Lead, Acetate of Copper, and Acetate of Iron. O. Jacobi, Philadelphia, Pa.

94,220.—Printers' Ink. C. Kregei, Scranton, Pa.

94,228.—Process of Preparing Wood-Fibre for Paper Stock. G. E. Marshall, Laurel, Ind.

94,246.—Process for Extracting Oils, &c. C. A. Seeley, New York.

94,297.—Manufacture of Illuminating Gas. C. F. Dunderdale, New York.

94,298.—Apparatus for Purifying Saccharine Liquids, and Curing, Drying, and Treating Sugar and other Materials. W. B. Espent, Spanish Town, Jamacia.

94,306.—Furnace for Producing Iron Direct from the Ore. W. Griffith, Jr., Pottsville, Pa.

94,343.—Evaporation for Sugar and other Liquids. T. Scantlin and J. M. Scantlin, Evansville, Ind.

94,359.—Mode of Bleaching Granulated Sugar. T. C. Taylor, Philadelphia, Pa.

94,360.—Apparatus for Carburetting Air and Gas. O. Tirrill, Boston, Mass.

94,374.—Roasting and Treating Iron Ores. H. Atkin, Falkirk, Scotland.

94,411.—Mode of Obtaining Fibre and other Products from the Maize Plant. J. T. Harris, Tyngsborough, Mass.

94,450.—Mode of Cooling and Freezing Liquids and other Substances. A. H. Tait, New York.

94,460.—Mode of Cleaning Musty Beer and other Casks. D. Willard, Jr., Pittsford, N. Y.

Issued September 7, 1869.

94,471.—Manufacture of Pig Iron. J. Burt, Detroit, Mich.

94,479.—Process of Preparing Grain for Mashing. F. W. De Spessbourg, Normandy, France.

94,508.—Apparatus for Assaying and Testing Ores and Metals. J. S. Phillips, San Francisco, Cal.

94,509.—Process of Concentrating and Granulating Saccharine Liquids. J. P. Wigan, England.

94,532.—Metallic Alloy for Filtering Oils, and for the Manufacture of Paints, Cements, &c. J. Webster, Birmingham, England.

94,581.—Compound to be used as a Mordant in Dyeing and Printing. F. S. Dumont, New York.

94,584.—Still. C. K. Dutton, Newbern, N. C.

94,596.—Manufacture of Illuminating Gas. G. W. Harris, Elizabeth, N. J., and H. Holdrege, New York.

94,605.—Composition Flux, for Manufacture of Iron and Steel. J. Jameson, Philadelphia, Pa.

94,611.—Apparatus for Distilling and Rectifying Spirits. G. Kaiser, New York.

94,626.—Preserving Wood from Decay and Mildew. A. R. McNair, New York.

Issued September 14, 1869.

94,736.—Artificial Marble or Plastic Material. H. A. Garvey, Memphis, Tenn.

94,797.—Sizing for Paper Manufacturers and others. Z. C. Warren and H. C. Hulbert, Brooklyn, N. Y

94,799.—Process of Rectifying and Refining Whiskey and other Spirits. H. Webster, New York.

94,805.—Composition of Liquids for Tanning. J. Wood, Woodstock, Vt.

94,832.—Compound of Hard Rubber and Fibrous Material. R. O. Lowrey, Salem, N. Y.

94,869.—Solution for the Treatment of Wood. E. W. Clark, Hartford, Conn.

94,880.—Manufacture of Beer, Ale, and other Fermented Liquors. J. Firmenich, Buffalo, N. Y.

94,898.—Apparatus for Carburetting Air. J. Lafrogne, Paris, France.

Reissues and Extensions.

63,300, reissue 3,620.—Process of Preserving Wood and Timber. D. R. Prindle, East Bethany, N. Y.

13,416.—Improvement in Making White Zinc. J. E. Burrows, Newark, N. J.

10,722, reissue 3,629.—Fibre from Cane for Paper and for other purposes. K. Lowe and W. McTeer, Baltimore, Md.

56,044, reissue 3,640.—Composition for rendering Paints Fire-Proof. J. O. Swinney, Glasgow, Mo., and A. H. Pollock, Germantown, Ky.

BREVITIES.

CHANCELLOR WILLIAM CHAUVENET, of Washington University, of St. Louis, has resigned on account of ill health.

CHARLES A. SHAFFER, formerly assistant in the chemical laboratory at Union College, and who has lately returned to this country from Europe, where he pursued his studies at Göttingen University, has been appointed Professor of Analytical Chemistry in Cornell University.

PROF. CYRUS NORTHROP has declined the presidency of the Alabama State University.

PROF. BREWER, of the Sheffield Scientific School, and Prof. Whitney, of the Lawrence Scientific School, have travelled during the past summer in the Western Country. They visited the headwaters of the Arkansas River, naming two of the peaks Yale and Harvard.

THOMAS GRAHAM, M.A., D.C.L., F.R.S., died in London, September 18th, in the sixty-fourth year of his age. His name and reputation are familiar to every chemist. He has held the position of Professor of Chemistry in the University of Glasgow and in the University of London, and at the time of his death ably filled the position of Master of the Mint. His *Elements of Inorganic Chemistry* has been a leading text-book for many years.

PETER MARK ROGET, M.D., F.R.S., died in London, September 17th, in the ninety-first year of his age. His writings include a work on "Animal and Vegetable Physiology," the "Thesaurus of English Words and Phrases," and very numerous papers in the scientific journals and encyclopædias of England. He was Professor of Physiology in the Royal Institute, and a member of the leading scientific societies.

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THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Professor Stokes has spoken wisely in defining the object and aim of the British Association as the "giving a more systematic direction to scientific inquiry." Without doubt, this is the paramount design. It is true that the Association serves as a vehicle for the bringing together of scientific men from various parts of England and the Continent, and thereby promotes a fellowship and a good feeling which workers in the same field should ever possess, and which no paper-war should ever disturb; it is true that it often imports pure science into most unscientific regions, and makes, for the time being, the city honoured by its presence, the focus *par excellence* of scientific thought and activity; and in its train there follows a host of fervid devotees who cry aloud to the inhabitants of the honoured city, "What time ye hear the sound of the cornet, sackbut, psaltery, and all kind of music, ye are to fall down and worship the golden image which we have set up," and the people *do* fall down and worship; and papers are read, and lectures delivered, and *soirées* given, and excursions made, and Mayors exercise the most unbounded hospitality, and the people shout "Hail" till they are hoarse, and the Local Committee works like a galley slave, and all for the glory, and honour, and welfare of science. These things help to make up a great whole, but the real and principal *work* of the Association is the "giving a more systematic direction to scientific inquiry," and the granting of sums of money for well indicated and defined purposes of research. It is by this means that the Association really influences the scientific world; it is by this means that it is leaving its impress upon the scientific progress of the age—an impress which will remain clear and distinct when all lesser matters shall have faded away, the men, the times, the very cities which received them, the very countries which gave them birth, each and all more evanescent than "*scientia immutabilis;*" each and all more destructible than facts "*travaillés jusqu'à indestructibilité.*" Francis Bacon has well compared the modes of research to the three ways of walking in the dark, for a man may either grope about as best he can, or he may be led by the hand of another, or he may direct his steps by a lantern, the last applying to the trying of experiments in definite order, with a determinate design, and in accordance with recognised laws of thoughts, and surely the Association both holds a lantern and leads by the hand when it gives "a more systematic direction to scientific inquiry."

There is no denying the fact that the year which has passed has not been brilliant in scientific results; yet it has been a year for much steady work. It is notable rather as a time for collecting particulars than as a time for the formation of generalisations. It is not that Nature has piped unto us and we have not danced,—it is not that we have ceased to torment phenomena by every known process which can lead to the revealing of secrets, but rather because there can never be a succession of great and notable discoveries or developments either in philosophy, or art, or science; an uniform progression either for good or for evil is an impossibility, and we must neither desire nor expect it. We may well rest content with our extended knowledge of the constitution of the sun as the dominant scientific result of the year which has intervened since the meeting of the British Association was held in Norwich.

ON THE MANUFACTURE OF CHLORINE BY MEANS OF PERPETUALLY-REGENERATED MANGANITE OF CALCIUM.*

BY WALTER WELDON, F.C.S.

Since the last meeting of the British Association, chlorine has begun to be manufactured extensively by a process which depends on the production and perpetual regeneration of a compound no mention of which, so far as I can find, as yet exists in chemical literature. As this process, besides thus producing and continually re-producing what I believe to be a new compound, reduces, by fully 80 per cent, the principal item in the cost of the manufacture of chlorine, greatly increases the quantity of chlorine which can be practically obtained from a given quantity of hydrochloric acid, and, moreover, enables the manufacture of chlorine to be carried on without the production of any offensive residue, I have ventured to think that a very brief account of it might not be without interest to this Section.

What has hitherto been the ordinary process of manufacturing chlorine consists simply in digesting with hydrochloric acid ores containing peroxide of manganese. The reaction which takes place, besides liberating chlorine, produces chloride of manganese, which remains behind in solution after the chlorine has gone off, and has hitherto been usually thrown away. There have been proposed and tried a great number of processes for transforming this chloride into peroxide for use over again; but the only one of them which has met with the slightest measure of practical success, prior to that which is the subject of this paper, is the one which is known, from the name of its inventor, as Dunlop's process. Dunlop's process decomposes the chloride of manganese by heating its solution, under a pressure of from two to four atmospheres, with milk of carbonate of lime, and then, in the dry way, transforms the resulting carbonate of manganese into a mixture or compound of two equivalents of peroxide with one equivalent of protoxide, by subjecting it for forty-eight hours to the action of air at a temperature of about 600° Fahr. The product of Dunlop's process is a sufficiently satisfactory one, containing about 72 per cent of MnO_2; but the process requires a very formidable amount of apparatus, and, in this and other ways, is so costly that its use has never been extended beyond a single firm of manufacturers.

Three years ago, I began to endeavour to work out the idea of decomposing, by either lime or magnesia, the chloride of manganese in the residual liquors of the chlorine manufacture, and then blowing air through the resulting mixture of hydrated protoxide of manganese with solution of chloride of calcium, or of chloride of magnesium, as the case might be. I took for granted that one-half of the protoxide of manganese so treated was the largest proportion of it that could thereby be

* Read before the British Association, Exeter meeting, Section B.

[English Edition, Vol. XX., No. 510, page 109.]

converted into MnO_2—in other words, that one could obtain only sesquioxide by this method; but it was soon found that, when using lime to decompose the chloride of manganese, considerably more than half the protoxide operated upon was frequently converted into MnO_2. It was found, eventually, that more than half the protoxide was thus peroxidised only when more lime was used than simply the quantity necessary to decompose the chloride of manganese, and when what was treated with air was thus a mixture of protoxide of manganese and lime; and it was also found that in all such cases there was a definite relation between the quantity of lime associated with the protoxide of manganese and the quantity of the protoxide, in excess of half, which became peroxidised. This led to the discovery that, whereas when protoxide of manganese by itself is treated with air in the wet way, one-half is the maximum proportion of it which can thereby be converted into MnO_2, the association of a certain proportion of lime with the protoxide so treated will enable the whole of it to become converted into MnO_2. It is to this fact, together with that of the much greater rapidity with which protoxide of manganese can be peroxidised by treatment with air in the wet way when lime is present than when lime is not present, that the practical success of the new method of manufacturing chlorine is mainly due.

The action of lime in increasing the proportion of protoxide of manganese which can be peroxidised by treatment with air in the wet way evidently consists in the lime substituting itself for that part of the protoxide which, when protoxide of manganese not having any other basic substance associated with it is treated with air in the wet way, does not undergo peroxidation. It would seem that the production of MnO_2 in the wet way by direct combination between hydrated MnO and atmospheric oxygen absolutely requires the presence of a base with which the MnO_2 can combine as it forms. When protoxide of manganese not having any other basic substance associated with it is treated with air in the wet way, a part of the protoxide itself has to act as the required base; and this is the reason why, in that case, not more than half of the protoxide can become peroxidised, the other half being required to combine as MnO with the half which becomes converted into MnO_2. When, however, the protoxide of manganese which is treated with air in the wet way has lime associated with it, the MnO_2 which forms (or part of it, according to the proportion of lime present) combines with CaO instead of with MnO, thus leaving free to undergo peroxidation that part of the MnO which, but for the presence of the CaO, this MnO_2 must have combined with, and which would thus have got locked up in a state in which it would have been incapable of being peroxidised, at least in the wet way and by air alone. Hence, the presence of enough lime to take the place of that half of the protoxide which, if no lime were present, would have to go into combination as base, and also to supply enough base for that half itself to combine with after undergoing peroxidation, will enable the whole of the MnO operated upon to be raised to the state of MnO_2. The minimum quantity of lime which is enough for this purpose is an equivalent for each equivalent of MnO operated upon, or the quantity necessary to supply an equivalent of lime to all the MnO_2 which can be produced by the peroxidation of all the MnO.

By treating with air, then, a mixture of protoxide of *manganese* and lime suspended either in water or in solution of chloride of calcium, there is formed a compound containing MnO_2 and CaO, in the proportion of an equivalent of one to an equivalent of the other. This compound may be regarded as sesquioxide of manganese, or Mn_2O_3, the MnO in which is replaced by CaO. I call it manganite of calcium, and I believe it to be a new compound. Gorgrew, in 1862, described a compound which he called manganite of calcium; but his compound contained five equivalents of MnO_2 per equivalent of CaO, and the CaO in it was so feebly combined that it readily decomposed chloride of manganese. My compound contains only one equivalent of MnO_2 per equivalent of CaO, and has no action upon salts of manganese.

This compound has now been produced and re-produced to the extent of some hundreds of tons. The process of producing it and applying it to the manufacture of chlorine is conducted as follows:—The residual liquor which remains after a charge of manganite has reacted upon hydrochloric acid in any suitable still is run from the still into a well or other receptacle, in which it is treated with carbonate of lime, to neutralise any free acid, and to decompose any sesquichloride of iron or sesquichloride of aluminium which may be contained in it. The neutralised liquor is then pumped up into an elevated cistern, in which it is left at rest for a few hours, in order that it may deposit certain solid matters which it now holds in suspension. The most abundant of these is usually sulphate of calcium, due to the somewhat considerable quantity of sulphuric acid which is nearly always contained in the hydrochloric acid produced in alkali works; but there are also small quantities of sesquioxide of iron, derived from the sesquichloride of iron in the hydrochloric acid, and sometimes partly from the lime used in the process, and larger or smaller quantities of alumina and silica, due to the lime. These impurities having deposited, the supernatant liquor, which is a mixed solution of chloride of manganese and chloride of calcium, and is now quite clear, and of a beautiful rose-colour, is run off into another vessel, where there is added to it the quantity of lime necessary to decompose the chloride of manganese in it, and nearly an equivalent more. A blast of air is then injected into the resulting mixture, and what was at first a perfectly white mud (all the manganese in which was in the state of MnO) soon becomes a very black mud, nearly all the manganese in which is in the state of MnO_2. This is then allowed to settle for about twelve hours, at the end of which time it has separated into a denser black mud and a supernatant, clear solution of chloride of calcium. This solution of chloride of calcium having been drawn off, what remains is ready for use in the still. It is used as mud, without drying, being conveyed to the still by pipes, and entering by a hydraulic lute. In the still it meets with hydrochloric acid, from which it liberates chlorine, at the same time re-producing exactly such a residual solution as was commenced with. With this solution, the round of operations is re-commenced, and so on, over and over again, continually. The samples I exhibit are portions of a charge of manganese which, at the works of Messrs. J. C. Gamble and Sons, of St. Helen's,—where this process has been worked out, by the liberal co-operation of Lieut. Colonel Gamble, the proprietor of those works, and the invaluable assistance of Mr. Bramwell, the very able manager of them,—has actually generated chlorine from which bleaching-powder has been made, something like fifty successive times.

[English Edition, Vol. XX., No. 510, pages 109, 110.]

Hitherto, the principal item in the cost of chlorine has been that for native peroxide of manganese. Last year, in Great Britain, France, Belgium, and Germany together, there were produced about 120,000 tons of bleaching-powder, which cost, on an average, for native oxide of manganese, not much, if any, less than £5 per ton. My process substitutes for this cost for native oxide of manganese a cost for the regeneration of manganite of calcium not exceeding fifteen shillings per ton of bleaching-powder, being about ten shillings for lime, one shilling for steam, one shilling for wages, and two shillings for interest and wear and tear. Moreover, whereas hitherto, at least in this country, and in all but an extremely few exceptional cases, the production of a ton of bleaching-powder has required the acid from about 75 cwts. of salt: my compound yields chlorine enough for a ton of bleaching-powder from the acid from less than 45 cwts. of salt. This larger yield of chlorine is mainly due to the artificial manganite being so easily soluble that it can very readily be caused to neutralise from 95 to 99 per cent of the acid employed, which is a very much larger proportion than can be neutralised when working with manganese ores. A third very important advantage of the new process over the old one consists in this—that, whereas the immense quantities of acid which escape neutralisation in the old process are usually—and have almost necessarily to be—sent into the rivers as free acid, the only product of the new process which has to be thrown away is a perfectly neutral solution of chloride of calcium.

Seeing that manganite of calcium, or $CaMnO_3$, is only of the very same value precisely in respect of the quantity of chlorine which it can liberate from a given quantity of acid as sesquioxide (otherwise manganite of manganese, or $MnMnO_3$), it may be well to explain why it is preferable to produce and re-produce the former rather than the latter. The reasons for this are two. There is, firstly, the obvious reason that, when all the manganese is converted into MnO_3, twice as much work is done per given bulk of material operated upon as when only half the manganese is converted into MnO_2; and this, of course, would be a very important consideration, even if the transformation of chloride of manganese into manganite of calcium occupied the same time as its transformation into manganite of manganese. Really, however (and this is the second reason), the former operation, in which all the manganese is converted into MnO_2, does not occupy more than one-fifth of the time required for the latter operation, in which only half the manganese is converted into MnO_2; and hence, while the manufacture of chlorine by means of perpetually-regenerated manganite of calcium effects the very considerable economy above stated, it is questionable whether chlorine could be manufactured by means of manganite of manganese regenerated by the same method so cheaply as by means of manganese ores.

The length of time which, when protoxide of manganese by itself is treated with air in the wet way, is required for its complete conversion into sesquioxide is very remarkable, and the fact that hydrated protoxide of manganese is somewhat freely soluble, alike in water and in neutral solution of chloride of calcium, would seem to have something to do with it. It is a curious fact that the peroxidation of protoxide of manganese by treatment with air in the wet way is greatly retarded by the presence in the medium in which the protoxide is suspended of any proto-compound of manganese in the state of solution. Thus, in a solution of either chloride or any other proto-salt of manganese, peroxidation will go on only extremely slowly; and solution of the protoxide itself, which will be present until the very end of the operation when protoxide alone is treated with air in the wet way, has the same retarding influence. On the other hand, when treating with air a mixture of protoxide of manganese and lime suspended in solution of chloride of calcium, there are formed solutions containing peroxide of manganese, in the presence of which peroxidation goes on with extreme rapidity. All these solutions are more or less deeply coloured, solution of the protoxide being without colour. I exhibit a sample of one of the coloured solutions, called by the workmen "the port-wine solution." The nature of these coloured solutions has not yet been fully investigated, but I believe them to consist of manganite of calcium dissolved in solution of oxychloride of calcium.

I may be permitted to mention, in conclusion, that, while there is every prospect, from the rapidity with which the new process of manufacturing chlorine has been and is being adopted both in this country and on the Continent, that, within a period to be measured only by months, nearly all the chlorine made in the world will be made by it, there is every likelihood that, in nearly all cases, a portion of the hydrochloric acid saved by it will be applied to the recovery of sulphur from alkali-waste. The chief reason why the recovery of sulphur from alkali-waste has been so little practised hitherto is that the manufacturers have considered it more profitable to use all their acid for the manufacture of bleaching-powder than to use any part of it for the recovery of sulphur; but the process which I have had the honour to describe will enable them to make even more bleaching-powder than they have made hitherto, and yet have enough acid left to permit of their applying to all their alkali-waste the only process for the recovery of sulphur therefrom which as yet has been found practically successful; and I am able to state that this application of a portion of the acid saved by my process will be extensively adopted.

ON ELECTRIFICATION.*

BY THOMAS T. P. BRUCE WARREN.

ELECTRICIANS must have noticed this singular phenomena at the very earliest date of testing; but it is very certain that it has been until now regarded as an unintelligible and uncertain property of an insulator.

The paper read by Mr. Warren has contributed greatly to our knowledge of its effects, so that it no longer remains the inconvenience that it had been to electricians; for he has shown that the laws which it follows admit of being formularised.

We notice that these researches have been carried out on cores of Mr. Hopkin's manufacture, several miles of which were tested under the varied conditions stated by the author. He believes that the very excellence of Mr. Hopkin's insulated wires has enabled him to examine so completely the whole of the subject.

ON THE NEW METHODS OF ESTIMATING THE AMOUNT OF REDUCED PHOSPHATES.

BY JOHN HENRY CHESSHIRE.

IN a case recently tried at the Gloucester assizes, a dis-

* Abstract of a paper read before the British Assoc meeting, Section A.

pute arose whether reduced phosphates could be estimated correctly. Notwithstanding the weighty evidence of Dr. Voelcker and others to the contrary, it was decided in the affirmative, and it was proved by the results of a series of experiments, conducted by men of equal scientific attainments, who pronounced my method (the bicarbonate of soda process) to be the one upon which the greatest reliance could be placed.

The plan I propose is as follows:—Take 1 grm. superphosphate, extract the soluble part. To the residue add 5 grms. bicarbonate of soda, ¼ of a litre of cold water, and boil from two to three hours; filter, wash, &c. To the filtrate add hydrochloric acid in excess, then tartaric acid and the magnesia mixture in the usual way.

I now propose to tabulate a series of experiments, showing, side by side, the results of the oxalate of ammonia, and the bicarbonate of soda processes.

No. 1. Action of 10 grms. bicarbonate of soda on 1 grm. Bedford and Cambridge coprolite, with a ¼ of a litre of water, and boiling for two hours—soluble phosphate = 0·97 per cent.

No. 2. Action of 5 grms. bicarbonate of soda on 1 grm. Bedford and Cambridge coprolite, with a ¼ of a litre of water, and boiling for two hours—soluble phosphates = 0·69 per cent.

No. 3. Action of 5 grms. bicarbonate of soda on 1 grm. (so-called) gypsum, with a ¼ of a litre of water, and boiling for two hours—soluble phosphate = 0·83 per cent.

No. 4. Action of oxalate of ammonia on 1 grm. gypsum, with a ¼ of a litre of water, and boiling for half an hour—soluble phosphate = 0·97 per cent.

No. 5. Action of 5 grms. bicarbonate of soda on 1 grm. gypsum, with a ¼ of a litre of water, and boiling for two hours—soluble phosphate = 8·98 per cent.

No. 6. Action of oxalate of ammonia on 1 grm. gypsum, with a ¼ of a litre of water, and boiling for half an hour—soluble phosphate = 8·45 per cent.

No. 7. Action of 5 grms. bicarbonate of soda on 1 grm. steamed bone, with a ¼ of a litre of water, and boiling for two hours—soluble phosphate = 0·69 per cent.

No. 8. Action of oxalate of ammonia on 1 grm. teamed bone, with a ¼ of a litre of water, and boiling or half an hour—soluble phosphate = 2·18 per cent.

No. 9. Action of 5 grms. bicarbonate of soda on 1 grm. guano, with a ¼ of a litre of water, and boiling or two hours—soluble phosphate = 1·25 per cent.

No. 10. Action of oxalate of ammonia on 1 grm. guano, with a ¼ of a litre of water, and boiling for half an hour—soluble phosphate = 2·11 per cent.

I obtained these results, 4, 6, 8, 10, by taking care to have only a slight excess of oxalate of ammonia at the end of the half hour's boiling.

Nos. 1 and 2.—My usual results with bicarbonate of soda have been only ½ per cent, but, as ½ a milligramme makes a difference of about 1-14th per cent, the results are practically the same.

Nos. 3 and 4.—The so-called gypsum is the waste after the soluble phosphate has been extracted from a superphosphate made from a mineral phosphate. It contained 12·57 per cent unacted-upon phosphate.

Nos. 5 and 6.—A superphosphate made from Bedford coprolite. I extracted the soluble portion, and worked on the remainder for the reduced. It contained 2·01 per cent unacted-upon coprolite.

Nos. 9 and 10.—A sample of good guano, which I boiled for half an hour, filtered wash, &c., and worked on the remainder for the reduced.

You will see by these experiments that you can distinguish between reduced phosphates and unacted-upon coprolite; and, if Mr. Hughes will take care to have only a slight excess of free oxalate of ammonia at the end of half an hour's boiling, his results will not be so high.

83, Newhall Street, Birmingham,
August 20th, 1869.

ON THE

EXAMINATION OF WATER FOR ORGANIC MATTER.*

BY R. ANGUS SMITH, PH.D., F.R.S., &C.

(Continued from Am. Repr., Sept. '69, p. 144.)

There are two columns giving the amount of oxygen required by the Clyde water. One giving the grains is correct, but, in altering the mode of expression, an error occurred not in the original. The amount in the 2nd is in 100 millions.

Having had occasion to examine another stream, very slow, rather a canal, receiving sewage, and flowing about twenty miles, the following results were obtained with the chameleon:—

Oxygen Required by the Decomposed and Decomposing Matters.

Grains per gallon.	
2·835	1·205
1·249	1·630
1·949	1·205
1·170	1·453
0·425	0·425
0·815	0·177

The gradual diminution of the decomposed organic matter is here seen very plainly. As new sewage comes forward in certain places, the amount rises.

These numbers correspond entirely with the apparent condition of the stream; they do not, however, correspond with the total volatile matter, which was as follows:—

Volatile matter.	Fixed matter.
9·33	44·27
6·23	28·91
3·99	24·08
3·08	36·75
3·43	31·85
4·16	30·31
5·22	29·92
5·04	69·30

I believe the results obtained by the chameleon are more useful in a sanitary point of view than the other results.

Let us take another case.

When heavy rains drove the impure water forward, the chameleon gave the following:—

Oxygen in Grains per Gallon Required for the Decomposed and Decomposing Matter.

0·992	1·106
0·284	1·134
0 638	1·276
0·709	1·347
0·992	

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations, by the author).

In such a case, the ordinary analysis gave—

Volatile matter.	Fixed matter.
4·20	20·72
4·48	21·21
7·14	26·39
6·02	34·02
4·27	28·28
4·69	32·27

These latter do not at all show the fine distinctions made by the permanganate, which agrees entirely with our senses, and may be used instead of them for putrid substances.

The permanganate must be used with consideration, like all other chemical tests. We must be careful that there are no lower metallic oxides in the water, which will remove the colour as suddenly as the sulphuretted hydrogen from putrid matter. Much has been said against the permanganate; but nothing even pretends to do what it does. Those who neglect it leave out the putrid matter, or drive it off in boiling. If it is used as the only reagent the results are certainly without value.

Nitrites decompose chameleon instantly. They are the result of the oxidation of azotised matter, and must be estimated.

The decomposition of the chameleon may be caused by the organic matter present, or by nitrites, &c. The presence of nitrites or nitrous acid will show if the organic matter is only recently oxidised.

Generally, there may be found organic matter and nitrites together, showing that some is oxidised and some ready to become so.

Schönbein has found traces of nitrous acid in the efflorescence of walls. In judging of the time, we must make allowance for this, and not judge from small traces such as he alludes to.

When nitrites and organic matter are found together, they may be estimated separately: the chameleon will be decomposed by both. 158 of chameleon solid is equivalent to 95 of nitrous acid, or 1000=606. It will be necessary to find one of the substances separately, and to subtract it from the whole, in order to find the amount of the second.

The amount of nitrous salts may be found by using ozone-paper, that is, paper with iodide of potassium and starch. The water to be tried is made acid with a little dilute sulphuric acid—not more than three drops to 1000, and a drop put upon the paper. If nitrous acid is present, it becomes blue. This blue is obtained immediately by putting a drop of the solution on ozone-paper when there is 1 of NO_3 in 30,000 of water; and, by waiting patiently, and giving time, it may be seen with much less.

In order to find how much nitrite is in water, the solution may be diluted until the reaction ceases to be distinct, even after waiting. The amount in the water will then be 1 in 100,000. If, in another case, when we find the reaction distinct in water, we take 100 grains and add 900 to it and find it beginning to be indistinct, the undiluted quantity must have been ten times as strong as the diluted. The amount in the 1000 grains is 1 in 100,000; the amount in the 100 grains is ten times as great, or 1 in 10,000; and thus we may arrive sufficiently near to the total amount. The amount of water added in order to bring the reaction to the adopted minimum is the measure of the strength of the solution.

A test like this depends partly on the eye and partly on the delicacy of the test-paper. The same result will be attained if the same eye and tests are regularly used.

The method of testing with paper is not so refined as the use of a larger amount of water—say 1000 to 10,000 grains. With this amount, the presence of 1 of NO_3 in 3¼ millions of water may be detected on adding starch and iodide of potassium. Three drops of sulphuric acid are also added to the 1000 grains, *i. e.*, 3 grains by measure. If no nitrous acid is present, no blue colour will be seen with this amount. If nitrous acid is present, the colour will begin in a few seconds. Some may prefer one way, and some the other. I do not look on this as quantitatively very exact; I simply thought it a useful method. Some more work is required.

The methods given of estimating the amount of nitrous acid are minimetric, proceeding by dilution instead of concentration. The value with gases is better known than in liquids; but it is believed that it will be sufficiently exact with the latter in cases where pure scientific accuracy is not attainable and not necessary, and where it is important to save time, labour, expense, and patience.

Now suppose 1000 of the water decolourise 5 of chameleon, we must subtract from 5 the amount which would be due to the NO_3, which then would give the amount of chameleon solution decomposed by the organic matter.

The estimation of both is interesting; but it is much more important to obtain the total chameleon used, as the presence of NO_3 must be considered a great objection to water, partly on its own account, and chiefly because of its origin.

It is to be observed that water containing much animal matter becomes extremely acid. It is a common thing to find water extremely clear, with no apparent organic matter; even on standing, also, extremely acid, and retaining nitrates. I have found it so filled that it appeared to flow less readily than pure water, and had a most nauseous taste. It was close to a churchyard, and was considered excellent water. This perversion of taste is difficult to understand, but it must be combated; it is not natural, and causes illness and death. This acid water is an excellent solvent of metals; and, if lead is present, the solution becomes rapidly so strong as to taste of the metal. This acidity, in conjunction with nitrates, does not, so far as I know, exist when the organic matter is very old—probably because the organic acid is oxidised. Some of it—probably all—is caused by the formation of organic acids. Similar organic and entirely colourless solutions, acid, but free from nitric acid, may be found by allowing peaty water to stand, without evaporation, but in contact with the air, for some years.

In the nitrous waters, no organic matter will be apparent on burning, unless there is more than the acid can oxidise. A very white ash is, therefore, a suspicious circumstance; and, unless the matter is extremely free of organic matter, this white ash is a certain indication of nitric acid. If there is a great deal, the ash melts readily. By white is meant white as soon as it is incinerated.

These acid nitrous waters contain phosphates generally. Phosphate of lime, or even alumina and iron, may be precipitated from them by ammonia, if they are direct from animal matter, and have not passed through porous matter sufficient to deprive them of some of the less soluble substances.

There are many interesting questions to be asked

regarding nitrates. I am inclined to think that their presence shows that the most dangerous state of the organic matter is past. When they appear in any solution, the chief escape of putrid gas seems to have ceased; the water may, however, be still dangerous to use, and, of course, is revolting to the imagination. It will be well to examine how far these suspicions are correct. When complete nitrification has occurred, all that class of evils arising from organic matter direct are prevented.

This paper was written for a special purpose, and does not pretend to say all that may be said regarding organic matter in water. As to the purification, there are many points to be observed. It has been generally held that nitric acid is the ultimate form which nitrogenous substances of organic origin assumes; but we must remember that plants have the power of decomposing nitrates, and of using the nitrogen for their own purposes. There are conditions, therefore, in which the organic matter may be entirely removed from water; and, when we remember how readily soils absorb phosphates and potash, we easily see why common salt should chiefly be left. The oxygen of the nitrates may even be used for the purification of water, whilst the earthy salts and phosphoric acid are precipitated. This operation of decomposing the nitrates seems to be the final one which is at hand for purifying water, and probably explains the marvellous results we frequently see. This decomposition is performed by living plants apparently; but some observations seem to indicate that the effect may be produced by the organic dead matter in water. The nitrates found in plants by Schönbein may possibly have been formed from the nitrates by deoxidation.

Animal and Vegetable Matter—The Common Salt of Sewage.

This subject deserves a further separate treatment.

As animals are formed out of vegetables, the elements which compose each are of course the same; and even the proximate organic principles are difficult to distinguish, especially in a state of decomposition. Still, it is remarkable what a clear insight is given into the quality of water by simply boiling down a few thousand grains and burning the residue. We can, by the eye and the smell, detect humous or peaty acids, nitrogenous organic substances and nitrates, and estimate their amount to a very useful point of accuracy. There may be times when this is the only experiment that can be made. After doing this, and trying other methods many hundred times, I still return to it as delicate, and little liable to fail. The want of numerical results is a serious objection, rendering the plan unfit for use when public reports are to be made of the analyses; but it is an excellent guide for the chemist in his laboratory: we may even decide by it the animal or vegetable origin of the matter.

This, however, is not enough; we require to obtain some knowledge of the quantity as well as of the quality, and we even require to know something of the previous history of the water, supposing decomposition to have gone so far that nothing definite can be affirmed as to the organic substances. It has already been shown that the carbon and the nitrogen may entirely disappear, the phosphorus may be precipitated, and the sulphur be, to a large extent, removed, nothing whatever remaining of the original substances, except alkalies, some of the alkaline earths, and chloride of sodium, or common salt. The latter, in reality, is the only substance which, so far as I know, is neither dissipated nor precipitated in whole or in part, potash excepted. The common salt, therefore, may be taken as an indication of the amount of original or organic matter, if we subtract from it any portion which we know to have appeared originally connected only with inorganic substances.

Perhaps all natural waters contain common salt; although rain, in a quiet day, and in a clear district, is nearly free from it, possibly, in some places, entirely so. In passing through the soil, it always collects some chlorides; some of these are the measure of the amount of vegetable matter decomposing in the soil. If we were to estimate the amount of chlorides dissolved by the water alone out of the inorganic soil, and subtract that from the total, we should obtain the amount dissolved by the action of vegetation breaking down the rocks or soil allowing for rain also. If the organic matter were decomposed, the common salt would still flow down the streams, and tell its tale. These quantities, however, vary excessively on every soil, and in every climate, and with every wind, and degree of wind.

The common salt which comes down our streams comes from the wear and tear both of animals and vegetables in the process of living. We cannot tell which comes from the animals and which from the vegetables.

From pasture-land, and land generally, the greatest amount is from vegetation; and, if we collected the organic matter, we should find also there that vegetation gave the greatest amount of matter, except from recently-manured fields, or when the water comes from shallow or surface drains, where the land had upon it a good deal of animal matter.

When, however, we come to towns, or great collections of animals, the chlorides, as well as the organic substances with which they are allied are the products mainly of changes taking place in animal life. Let us compare the amount of chlorides to be found in plants and in animals.

Chlorides in the Blood of Animals (Nasse and Poggiale in Gmelin) *as Chloride of Sodium in* 1000 *parts.*

Dog	4·490
Cat	5·274
Horse	4·659
Calf	4·804
Goat	5·175
Sheep	4·895
Rabbit	4·092
Swine	4·281
Goose	4·246
Hen	5·396

If we take the ashes, the amount is, according to Stölzel,

Forox blood	51·190
Forox flesh	4·860
Ashes of the serum in man*—	
Chloride of sodium	61·087
Chloride of potassium	4·085
The ashes of the blood in man	57·641
The ashes of the blood of the horse, according to Lehmann	67·105
Urine	22·972

But, as the latter is produced so rapidly and frequently it is the greatest and most constant source of common salt. No plant can be compared with animals in this respect.

* Robin and Verdeil's "Traité de Chimie Anatomique."

CHLORIDES IN VEGETABLE MATTER.

Ashes.	Name of Plant.	Chloride of Sodium.						Chloride of Potassium.					
	Wheat grain	0·27	0·55	0·64	1·60	0·34	Way and Ogston.						
	In the whole ash		10·00	Weber.									
	Ripe oats. Grains	0·92	0·07	0·45	1·24		Way and Ogston.						
		(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
	Buckwheat straw	4·55	3·01	3·19	3·75	3·38	1·69 E. Wollf.	7·41	26·93	0·77	3·13 E. Wollf.	6·85	9·70
	Barley straw with chaff		3·07	5·68	2·14	4·37		.....	0·90				
				5·56	Way and Ogston.								
	Barley grains	0·56	1·44	0·41	0·61	0·72	1·59	.....	1·29				
				2·01				.....	1·93		Way and Ogston.		
	Ripe oat straw, Middle			3·03									
	" " Bottom			15·36	J. P. Norton.								
	Radishes. Root			10·89	Herapath.								
	Chestnut.												
	Young wood								9·67				
	Green shell								15·42	2·20	Wollf.		
	Asparagus		7·97		12·94								
			Schlienkamp.		T. Richardson.								
	Tea	2·40	2·15	2·25	4·66	3·25							
			Spooner.		Twis.	Hague.	Homes.						
	Orange-tree. Root			1·18									
	" " Stem			0·25	Rowney and Blow.								
	Beech		6·68	0·62	Witting.								
	Birch		7·17	9·84	Witting.								

When animals decay, they must, according to the above analyses, give out much more common salt than the same amount of vegetable matter; and this we find to be the case in the drainage of grave-yards. But it is from living animals we find the greater amount of common salt: that which goes into the blood is rapidly thrown out; and, as we take with our food amounts varying from 100 to 250 grains of common salt per day—let us say 150, an equal amount must be abstracted from us. It is for this reason sewage water constantly is found to contain common salt, increasing according to the amount of sewage. For this reason, common salt is found in the saltpetre of all countries. It is a part taken from the blood of the dead or the living animal, remaining with the nitrogen unchanged, even when the organic matter has been so highly oxidised that nitric acid takes the place of albumen.

Pure spring, or very fine stream water, gives only a slight precipitate with nitrate of silver. This has a bluish tinge, not being dense enough to become white. When there is more than this slight precipitate, nitric acid is generally found, especially if the water has passed through porous materials.

These tests must be used and the inferences drawn with great discretion. We know that near the sea there may be found a certain amount of chlorides in the springs, rising, according to circumstances, until the water becomes brine. The same thing occurs near great deposits of salt, such as in Cheshire and elsewhere. There are, also, saline wells scattered over most countries, the origin of whose chlorides is quite unknown to us. There is in the rain driven violently from the sea an amount of common salt sufficient, on crystallising, to dim the windows of houses many miles inland. In manufacturing towns where coal is burnt, the rain contains more chlorides than rain in the country. Many large districts of tropical countries contain nitrates and common salt in the soil, but these salts in all probability result from oxidised animal matter. Chlorides are found in some districts in this country rather in excess of the average from superficial causes. But notwithstanding all these exceptions, which appear for the moment numerous, I must still consider that the test is one which may be generally used.

In England it is almost universally the case that the presence of much chloride in drainage water indicates drainage from animal matter, and no water containing chlorides to a great extent ought to be used without careful examination as to the source. One grain per gallon is too much, and is, in many places, to be suspected of being caused by impure drainage. Of course we must in this case, as in all inquiries, be careful that no disturbing causes intervene. In this country chlorides may be given out from manufactories, in which are constantly made chemical experiments sufficiently large to interfere with our accuracy, if we are not very careful.

It may be supposed here that I am adding many qualifications, but the same may be done in the case of nearly all experiments. No experiment is of value, unless it is viewed on all sides to prevent the admission of errors, and I do not know that more care is required

in this case than in many others. In the case of chlorides we learn readily the average amount in a district, either in the rain or the drainage, and we detect the smallest increase. Any amount of common salt above the average of the district obtained in a well in a city or camp, or near habitations of men or animals, is an almost certain proof of impure drainage; when the clue has been followed up, I have found the origin in a sewer or some such spot, times without number and for many years. The presence of the sea or manufactories, or of disturbed strata with mineral waters, will seldom, after all, cause any error with a careful person.

Nitrates are very common in small quantities. They are found in water from manured land, in gardens, wells near houses, and, as a consequence, in nearly all town wells; in great abundance near churchyards, if the drainage is direct. They are not necessarily found in sewage which has not flowed through strata. The amount from the atmospheric sources is so minute that it will not interfere with any inquiry regarding the wholesomeness of water at present.

Although caution must be exercised in drawing conclusions from the presence of the chlorides, their absence may be held as conclusive against the presence of decomposed animal matter, and excretions of animals in large quantities.

If chlorides and nitrates are found together in water, we may take it for granted that animal matter has existed there, or does exist in the water. Of course a very rigid scientific inquiry shows at once that vegetable matter may be present, especially from grain or seeds; but, practically, this need not affect the question, especially in a sanitary point of view, because, if this accumulation of vegetable matter occurred capable of giving as much nitrogen as animal matter, it would be sufficiently, and perhaps equally, hurtful when putrid.

If chlorides and nitrates are found in water still capable of decomposing chameleon, the presence of animal matter, or injurious gases or nitriles, may be assumed, a part only being oxidised.

If the chlorides and nitrates are present, but the power of decomposing chameleon absent, then animal matter in a putrefying state is absent, but whether it disappeared minutes or ages before is not shown by chemistry.

The chloride of sodium in a sewage stream of a very sluggish nature was estimated. The following numbers were obtained in a course of 14 miles:—

8·97	7·93
7·53	7·78
6·25	6·62
7·78	40·89

The numbers are pretty uniform, although they rise and fall with evaporation and the additions made to the stream; but whenever certain manufactures come in a sudden rise is observed. Before this occurs, I believe the chloride of sodium is a perfectly exact comparative measure of the amount of sewage. It may, in many cases, also be made into a positive measure. This will, however, depend on the mode of managing the sewers.

The conclusion simply is, that chloride of sodium is the most abiding constituent of sewer water, and, with due precaution, the best index of comparative amounts in the original sewage. When decomposition has not taken place, it may also be used for indicating the comparative strength or value of sewage water.

Perhaps it will be thought that in here speaking of the impurities of water, when the River Commissioners are making their inquiry in Lancashire, it would be better if I spoke less of the laboratory side of the question, and more of the great evils which have destroyed the beauty and use of our rivers. On one important point I am of the same opinion which, years ago, I expressed in this Society—that we waste an enormous amount of water. We throw into a stream, without compunction, impurities which will destroy the value of many hundred times, or, perhaps, thousand times, their bulk; and this evil may, to a certain extent, be cured with our present knowledge. We try in vain to take out that which we have thrown in. A large part of the evil can be cured by little trouble, although I confess that there is much remaining which demands more time and space than is everywhere conveniently found. Time and space, although by many treated as mere forms of thought, are expensive in Lancashire.

The following may be regarded as a summary of the results required for sanitary purposes:—

1. Quality of the organic matter.
2. Condition of the gases of decomposition.
3. Organic matter: easily-decomposed organic matter, and slow to decompose.
4. Nitrates as remnants of organic matter.
5. Nitrites.
6. Chlorides, with precautions, as indicating animal sources when greater accuracy is wanted.
7. Oxygen of the dissolved air as indicating the activity of the decomposition.
8. Total organic matter.
   (This the author found by weighing).
9. The usual inorganic analysis, to be spoken of in a second paper.

The author considered that, for purely sanitary purposes, the Nos. 1, 2, 3, and 6 were the most important.

The organic matter may be divided into many parts; nitrogenous into several parts; and carbonaceous into several. The total nitrogen has been taken by Dr. Frankland very carefully, and the mode of taking oxides of nitrogen improved. The division of the nitrogenous into separate parts has been begun by Wanklyn. The carbonaceous has not been much studied of late years.

ON SOME NEW SUBSTANCES EXTRACTED FROM THE WALNUT.*

BY DR. T. L. PHIPSON, F.C.S.

BETWEEN the shell and the kernel of the walnut there exists a thin membrane, called the episperm, which closely envelopes the cotyledons, and is composed here, as in most other fruits, of a double membrane, the inner one being very thin, quite white, translucid, and perfectly devoid of taste, whilst the external one is much coarser in structure, more or less coloured, has a very bitter, disagreeable taste, and contains the substances mentioned in this paper.

When the episderm of the walnut is digested for several hours in alcohol, it yields a yellowish liquid, from which a notable amount of gallic acid, ellagic acid, and a new species of tannin, which I will call *nucitannic acid*, or *nucitannin*, can be obtained. The latter is the principle to which the thin walnut skin chiefly owes

* Read before the British Association, Exeter meeting, Section B. Abstract by the author.

its disagreeable bitter taste; and this nucitannic acid possesses the property, when boiled for several hours with dilute hydrochloric acid, of splitting up into *glucose* and a red substance, which I will call *rothic acid*, the composition and properties of which I have fortunately been able to determine, although I started on this research last season with a very small supply of walnut skin.

Nucitannin is soluble in water and in alcohol, very slightly soluble in ether; it precipitates solution of gelatine, but not exactly like ordinary tannin does. The mixture solidifies only after a little time. It forms insoluble salts with lime and oxide of lead, and is left as a kind of yellow varnish, devoid of crystallisation, when its alcoholic solution is evaporated at a moderate temperature. Its composition has not yet been ascertained.

When an aqueous solution of nucitannin is boiled for eight or nine hours with dilute hydrochloric acid, the pale yellow liquid becomes more and more red, until it finally assumes a tint similar to that of a dilute solution of permanganate of potash. It is then allowed to cool, when the red substance, rothic acid, separates, along with some gallic acid and ellagic acid; these are collected on a filter, and the clear liquid which passes is found to contain glucose and gallic acid.

Rothic acid is separated from the other substances by a dilute solution of ammonia, and re-precipitated by hydrochloric acid; a second treatment gives it quite pure. It is a brownish red amorphous substance, combining readily with ammonia, potash, lime, &c.; its lead-salt is remarkable by being insoluble in cold acetic acid. Rothic acid is very soluble in alcohol; its solution exercises no particular action on the spectrum; it yields no absorption bands; it is, also, very soluble in ammonia. Dried at 100° C., it was found to lose water for a long time; it was, therefore, heated in an oil-bath to 118° C., and then burnt with chromate of lead. The analysis gave:—

		Calculated for $C_{28}H_{12}O_{14}$.
Carbon	57·81	57·52
Hydrogen	4·16	4·11
Oxygen	—	38·37

The lead-salt was formed by precipitating acetate of lead with an alcoholic solution of rothic acid; it forms an olive-coloured amorphous precipitate, which becomes brown when dried in the air, and appears quite black when dried at 100° C. It leaves metallic lead when calcined carefully in a porcelain crucible. 370 milligrms. of rothate of lead yielded, to analysis, 150 milligrms. of lead, or 40·5 per cent.

	Calculated for $C_{28}H_{12}O_{14},2PbO$.	Found.
Lead, per cent	40·2	40·5

The lime-salt of rothic acid forms a brownish precipitate, obtained by adding an ammoniacal solution of chloride of calcium to a solution of rothic acid. It is like the lead-salt in appearance, but contains only one equivalent of base:—

$$C_{28}H_{12}O_{14},CaO.$$

The rothates of potash, soda, and ammonia are soluble; the rothate of silver forms a fawn-coloured precipitate, which becomes darker on drying, but does not appear to be very sensitive to the action of light.

Rothic acid is a member of a rather numerous class of bodies, some of which are mentioned below:—

$C_{28}H_{12}O_{14}$ = 1 eq. rothic acid.
$C_{28}H_{12}O_{20}$ = 2 " gallic acid.
$C_{28}H_6O_{16}$ = 1 " ellagic acid.
$C_{28}H_6O_{18}$ = 2 " rutigallic acid.

Somewhat similar substances extracted from oak-bark, quinine bark, root of *Tormentilla erecta*, &c., appear, on analysis, to contain C_{26} instead of C_{28}.

I will reserve for a future occasion, an account of the preparation, properties, and composition of pure nucitannin; I may briefly state, however, that the alcoholic decoction of the walnut skin contains a substance described here as nucitannin, yielding, by the action of mineral acids, rothic acid, gallic acid, ellagic acid, and glucose; and, since ordinary gallotannic acid may be represented as a glucoside, yielding 3 eq. of gallic acid—

$$S\left\{\begin{matrix}G\\G\\G\end{matrix}\right\}-8HO,$$

it is possible that nucitannin may be—

$$S\left\{\begin{matrix}R\\G\end{matrix}\right\}-xHO,$$

in which R represents rothic acid, and takes the place of 2 eq. of gallic acid. If so, there is another tannin present in the walnut skin, an *ellagic tannin*—

$$S\left\{\begin{matrix}E\\G\end{matrix}\right\}-xHO,$$

which explains the fact that alcohol takes up, from the walnut skin, a substance yielding a notable amount of ellagic acid, these glucosides being all very soluble in alcohol, though the acid derived from them may be very much less soluble.

ON THE

DETECTION OF FIXED OILS IN PLANTS.*

BY T. T. P. BRUCE WARREN.

The object of this communication was to point out a simple method applicable, on a small scale, to the determination of oils in vegetable juices, &c.

To juice containing caoutchouc, hydrochloric acid is first added, to coagulate it. The residue is treated with bisulphide of carbon, which dissolves out the oily and fatty matter. The addition of dichloride of sulphur causes a granular precipitation in the clear decanted solution.

Fibrous substances are preferably treated with rectified ether, and the caoutchouc, if present, removed by the addition of alchohol, before digesting in bisulphide of carbon.

ON THE

PRESENCE OF SOLUBLE PHOSPHATES IN SEEDS.†

BY F. GRACE CALVERT, PH.D., F.R.S.

Soluble Phosphates in Cotton Pods.

Some results which I had obtained on the presence of the acid phosphate of magnesia in cotton fibre, and which I had the honour to lay before the Chemical Society some time since, induced me to continue these researches with a view of ascertaining if the same phosphate existed in the other portions of the cotton pod, viz., the husk and the seed, and, if not, whether the phosphoric acid existing in the same was combined with other bases. It will be, no doubt, also remembered that I found that the mean quantity of acid phosphate of magnesia, 2MgO,

* Abstract of a paper read before the British Association, Exeter meeting. Section A.
† Read before the British Association, Exeter meeting, Section B.

HO,PO_5, in ten samples of cotton fibre which had been imported from various parts of the globe, was equal to 0·05 per cent PO_5, or 0·084 $2MgO,HO,PO_5$.

But, before examining the nature and amount of phosphates present in the husk and seeds constituting the cotton pod, I deemed it advisable to repeat my former experiments, and to confirm them by separating the cotton fibre from the same pods from which I intended to submit the husks and seeds to analysis, and I am glad to say that I obtained results confirming entirely the previous ones, viz., that 100 parts of cotton fibre yielded, when repeatedly washed with water, a quantity of acid phosphate of magnesia = 0·084 of acid phosphate of magnesia, or 0·050 of phosphoric acid, and, further, as in my previous results, only a trace of potash and lime were found in solution, and that no other salts of magnesia existed in solution.

Husks.

To ascertain if the amount and nature of the phosphates in the husks of the cotton pods were the same as in the fibre, 14·45 grms. of husks were reduced to fine powder, and steeped for twelve hours with 250 grms. of distilled water. This operation was repeated four times each, and the whole of the washings were filtered off, evaporated to dryness, and the residue calcined, and the following results were obtained on the analysis of the ash:—Only a small quantity of magnesia and lime was detected, nearly the whole of the phosphoric acid being combined with potash and with oxide of iron. The following results being obtained—

One hundred parts of husk gave—

Phosphate of potash, 0·531 = 0·178 PO_5 combined with potash.
Phosphate of iron, 0·227 = 0·106 PO_5 combined with sesquioxide of iron.
Phosphate of lime, 0·030 = 0·016 only PO_5 combined with lime.
And a trace of magnesia.

Therefore the phosphoric acid in the husk is not combined with magnesia, as in the fibre, but with potash and oxide of iron, and the total amount of phosphoric acid, instead of being 0 050, as in the cotton fibre, is 0·300, or six times as large.

Seed.

I now proceeded to determine the composition and amount of phosphates in this portion of the cotton pod, and obtained the following results:—

0·650 of phosphate of potash.. = PO_5, 0·217
0·117 of phosphate of magnesia = PO_5, 0·069
0·025 of phosphate of iron..... = PO_5, 0·011

These results, which are the mean of two analyses, as in the previous cases, show that the phosphates exist in much larger quantity in the seed than in the other parts of the pod—being, in fact, about sixteen times as large as in the fibre, and between three and four times that found in the husk.

Thus the quantity of phosphoric acid and phosphate existing in the various parts of the cotton pod are—

	PO_5.
Husk	0·300
Fibre	0 050
Seeds	1·092

The above results reveal two important facts—viz., that phosphate of potash, magnesia, and iron predominate in seeds, and not the phosphate of lime, as it was erally admitted; also that the nature and amount phosphates vary with each part of the said pod. ıer, it will be observed, that, in the husk, the ıtes of iron and potash predominate; in the fibre, phosphates of magnesia; and in the seed, phosphates of potash and magnesia. And what increases the interest is that nearly the whole of the bases existing in the cotton pod are combined with phosphoric acid.

The Amount of Soluble and Insoluble Phosphates in Wheat Seed.

English White Soft Wheat.—220·8 grms. of very carefully picked and cleaned white wheat, dried at 230° F., were repeatedly washed with distilled water, and the washings evaporated, and the residue calcined, when only—

0·010 of residue was left, thus showing that water had little or no action upon the grain when acted upon in such a condition.

I therefore decided to act on the same grain when crushed, so that water could penetrate into the mass, and dissolve all soluble salts; but, before doing so, I deemed it advisable to determine the total amount of phosphoric acid existing in the wheat operated upon, and obtained, in one analysis, 0·633 per cent of phosphoric acid, and, in a second analysis, 0·677 per cent, or 55·5 on 100 parts of ash.

These results clearly show, as Fresenius has done before me, that nearly the total of the ashes left by wheat is represented by phosphates.

With a view of ascertaining what amount of these phosphates would be dissolved by water in crushed wheat, 50 grms. of white, crushed soft wheat, dried at 230° F., were placed in a bottle with 150 grms. of distilled water, mixed with a little carbolic acid, so as to prevent any fermentation, or the production of any acid. After twenty-four hours, the aqueous solution was removed, and a fresh quantity of distilled water added; and these washings were repeated until all mineral matter was dissolved, the whole of the washings were evaporated, and the residue calcined. The amount of phosphoric acid determined was equal to 0·394; therefore nearly two-thirds of the phosphoric acid or phosphates existing in wheat are soluble in water.

English Red or Hard Wheat.—I deemed it advisable to determine the total amount of phosphates and of soluble phosphates in red or hard wheat, as I had done in soft or white wheat, and thus found that 100 parts of red hard wheat, dried at 230° F., yielded 0·749 phosphoric acid; and that 100 parts of the same, when dried at 230° F., and crushed, yielded 0·376 of soluble phosphates.

I regret that I had not the opportunity of repeating these results on white and hard wheats obtained from various countries, or cultivated on different classes of soils, viz., clay, lime, or sand formations, as the phosphates are in larger proportion in red wheat than in soft, and that half the phosphates are soluble in the red wheat and two-thirds in the white soft wheat, and therefore I cannot, under these circumstances, assume that the difference in amount of the phosphates is due to the nature of the wheat, and not to the soil.

These results led me to inquire if the various parts which constitute the grain of wheat contain the same amount and nature of phosphates when separated by the successive and different operations carried out by a miller.

The results of my experiments, as it will be seen, have fully answered my expectations—viz., the phosphates in each section of the cortical parts of the grain do not so much vary in their nature as they do in quantity: their amount decreases gradually from the outer sections towards the central ones; thus, whilst

the flour contains only a trace of phosphates, especially soluble ones, the bran contains a large quantity.

The total amount of phosphoric acid in—

Bran.....1·682
Flour.....0·971

Soluble phosphates—

Bran.....1·264
Flour.....0·080

A large miller in the neighbourhood of this city having kindly consented to grind and bolt a few sacks of wheat, to enable me to obtain in a separated state the various parts constituting the grain, and placed in my hands the five distinct specimens, as representing in a rough way those various layers presented by a grain of wheat.

No. 1. Coarse bran.
No. 2. Coarse bran.
No. 3. Coarse sharps.
No. 4. Fine sharps.
No. 5. Flour.

Amount of Phosphoric Acid and Phosphates in the Various Parts of Wheat.

	Corn and bran.	II.	III.	IV.	Flour
Phosphoric acid combined with sesquioxide of iron	0·042	0·047	0·037	0·015	0·022
Phosphoric acid combined with magnesia and a small quantity of CaO	1·485	1·259	0·657	0·329	0·047
					0·144
Phosphoric acid combined with potash	1·071	1·046	0·459	0·280	0·758
Total—	2·598	2·352	1·153	0·624	0·971
Phosphate soluble in water.	1·942	1·666	0·918	0·529	0·080

These facts also tend to show that most of the phosphates contained in wheat are not combined with the organic matter, but are in a free condition.

Further, that the greatest part of the phosphates are soluble, and combined with potash and magnesia, whilst the insoluble phosphates are represented by lime, iron, with a small proportion of MgO, the latter salt being probably neutral phosphate of magnesia, $3MgO,PO_5$, whilst the salt of MgO in solution is $2MgO,HO,PO_5$; and what tends to support this view is that, although the same weights of bran were washed with the same quantities of water, and for the same space of time, the quantities of phosphates of magnesia decrease rapidly in each successive layer of the seed as we proceed from its external part towards its interior.

Also that, whilst in No. 1 bran only one-fifth of the phosphates are retained as insoluble, in No. 4 one-sixth remains in an insoluble condition.

These analyses clearly illustrate that, although habit and pride have gradually led us to prefer white bread to brown, or more so bread made with nearly the whole of the constituents of wheat grain, still this practice is an error when we consider the nutritious properties of wheat, especially as a food for children, when phosphates are so essential to the formation of bone and blood; and medical men would confer a great boon on society if they were to impress the importance of feeding children with a wheaten preparation in which all the constituents of the grain were preserved.

These views are further supported by some very interesting researches published in the *Comptes Rendus* by M. Mège Morries, in which he proved that there was, in the inner cortical parts of the wheat, a special ferment, which converted most rapidly starch into sugar, and thereby facilitated the conversion of wheaten flour into bread.

These observations of M. Morries led him to devise a peculiar mode of grinding wheat, and making bread from the flour thus obtained, and the results were such that, from every hundredweight of wheat, he was enabled to obtain of bread—

Wheat, 100.
Ordinary process.....70 flour.....92 bread
M. Morries.....82 " .....110 "

This method was so satisfactorily carried out that the Emperor of the French adopted it at the military bakery of Paris, in which bread is baked every day for 100,000 men.

In conclusion, I may be permitted to state that I am aware of the analyses of wheat which have been made by Professor Way and Dr. Voelcker, and especially of those remarkable and extensive researches published by G. B. Lawes, F.R.S., and G. H. Gilbert, F.R.S., "On the Composition of the Ash of Wheat Grain," and, by the last-named gentleman, "On Wheat Grain and its Product in the Mill." But the researches of these gentlemen only give the total amount of phosphoric acid in these products, but do not give, as I have attempted to do, the respective various proportions of phosphates of potash, magnesia, lime, and iron which exist in the various parts of wheat grain.

ON THE PHOSPHORESCENCE OF THE SEA,

AND ON

OZONE IN CONNECTION WITH ATMOSPHERIC CONDITIONS.*

BY J. MOFFAT, M.D., F.R.A.S., F.G.S., &c.

As it appears from results deduced from observations taken at sea, that ozone periods (as on land) commence, and that ozone is in maximum quantity with decreasing readings of the barometer and the conditions of the south or equatorial current of the atmosphere, and that ozone periods terminate with increasing readings of the barometer and the setting in of the polar current, and that phosphorus is luminous and non-luminous under similar conditions, I supposed that there might be some connection between ozone and the phosphorescence of the sea.

Observations are still taken, and I hope to be able to give results from a larger area. The following are deduced from observations taken between latitudes 58° and 79° N., and longitude 6° E. and 67° W.:—

Table I.

Shewing the Amount of Ozone with (at Sea)—

Barometer.		Directions of the Wind.				Phosphorescence.	
Increasing.	Decreasing.	N. to E.	S E. S. to W.	N.W.		None.	Brilliant.
2·9	4·7	1·6	2·7	3·7	3·2	2·4	3·0

* Read before the British Association, Exeter meeting, Section B.

TABLE II.

Shewing the Mean Reading of the Barometer, Mean Temperature, and Daily Mean of Ozone at the Commencement and Termination of Phosphorescence of the Sea, between latitudes 58° and 79° N., and longitudes 6° E. and 67° W.

Phosphorescence.	Barometer.	Thermometer.	Ozone.
Commencement of	29·46	34·8	2·9
Termination of	29·65	30·0	1·5

TABLE III.

Shewing the Mean of the Barometer and Thermometer, and the Daily Mean of Ozone, with Commencement and Termination of Periods of Luminosity of Phosphorus, deduced from the Observations of Six Years (on Land).

Periods of Luminosity of Phosphorus.	Mean of Barometer.	Mean of Thermometer.	Mean of Ozone.
Commencement	29·640	47·3	5·0
Termination	29·734	43·4	3·0

By these results, it appears that the phosphorescence of the sea and luminosity of phosphorus occur under similar atmospheric conditions.

The amount of ozone the day before phosphorescence 0·8
" " day of 2·5
" " day after 1·9

Of auroral displays, one was without ozone, and 50 per cent were accompanied by phosphorescence.

A FEW REMARKS ON THE

REDUCED OR PRECIPITATED PHOSPHATE OCCURRING IN SUPERPHOSPHATES.

BY ALFRED SIBSON, F.C.S.

THE fact of superphosphate "going back," or losing in soluble phosphate, on keeping, will hardly at present be disputed, the question at issue being whether the phosphate so reduced can be estimated or not.

It often happens that a quantity of superphosphate, which, when freshly made, contains, say, 25 per cent of soluble phosphate, is found, after keeping (in some cases only a short time), to have lost 2, 3, 5, or even more, per cent of its soluble phosphate; in fact, the paper of Mr. Sutton, which appeared two or three weeks since, and which, although averse to the above question, the superphosphate operated on is stated to have contained, originally, 23 per cent, while it then had only 17 to 18 per cent, or a loss of 5½ per cent. Instances of this kind are, however, familiar to all who have had much to do with this class of manures.

As it is, also, found impossible by the manufacturer to calculate upon the extent of this retrogression, it is a constant source of dispute between buyer and seller, and also tends to bring discredit on analysis, as there is no apparent reason why a superphosphate should contain less soluble phosphate at one time than it did at an earlier period; in fact, the contrary would naturally be expected from the concentration of the bulk through the loss of moisture.

There thus appears an urgent necessity for some means of determining the phosphate so reduced; and if a scientifically accurate method be not forthcoming, it appears to me only reasonable to be satisfied, under the circumstances, with some method which, for all practical purposes, gives comparative and reliable results; such a method I have found to be the following:—

The point is to find some reagent which does not affect the undecomposed coprolite (that being the mineral now more especially considered). I soon found that dilute acids, including acetic, citric, and oxalic (this least so), were objectionable on this account, and was led to try oxalate of ammonia, which, as a perfectly neutral salt, would be altogether unlikely to decompose a perfectly mineralised substance like coprolite. As well known, the decomposition of a gelatinous phosphate of lime by oxalate of ammonia is a quantitative reaction, which takes place at once, the only necessity for boiling being to assist the subsequent filtration. Boiling for ten minutes at the most is sufficient to effect this object, while the oxalate does not, under these circumstances, attack the coprolite to any material extent. I am aware this statement is somewhat at variance with the results of other contributors which have lately appeared, but, as the process they state differs from that I have adopted, the different results may, perhaps, be accounted for. I have no intention, however, of entering into a controversy on this subject, but give the full particulars of the process, so that any one interested in the matter can try it for himself. I have since found that oxalate of ammonia had been suggested by others for this purpose, but was unaware of the fact when I selected it.

25 grains of Cambridge coprolite are boiled, with an equal weight of oxalate of ammonia, in 2 ounces of water, for ten minutes, and filtered; the filtrate acidified with hydrochloric acid, and made alkaline with ammonia (merely to insure the presence of chloride of ammonium; and ammoniacal sulphate of magnesia added. No precipitate will probably be obtained; but, *if it be obtained*, it is not conclusive of the presence of phosphoric acid; and great errors may be made if a precipitate in this place be accepted as phosphate of magnesia and ammonia. After standing for two hours, the small precipitate is collected (which often resembles the phosphate closely, but consists of oxalate of magnesia, which sometimes separates from a concentrated solution, and a little oxide of iron) and re-dissolved in hydrochloric acid, citric acid added, and re-precipitated with ammonia. A precipitate, if now obtained, consists of phosphate of magnesia and ammonia only, and if burned and weighed as phosphate of magnesia in the usual way, will be found to amount to less than 0·50 per cent, calculated as bone-earth. This was found to be the case with coprolite ground as fine as it is possible to get it for analysis; but I have just been through the process again with coprolite in the state usually employed by manufacturers, and find no weighable quantity of phosphate of magnesia after standing three hours. I thus consider that 0·50 per cent of phosphate of lime is the utmost error that can be made by this process under proper management.

In the case of a superphosphate containing reduced phosphate, and treated as above, after having first extracted the soluble phosphate, by cold water, the phosphate of magnesia calculated as bone-earth will represent the phosphate so reduced.

I am aware of the new process, suggested by Mr. Chesshire, and adopted by the chemists for the plaintiff (with the exception of myself) in the late trial at Gloucester, referred to by that gentleman, and have, therefore, every confidence in its value, but have not yet satisfied myself whether it is superior to the plan I have hitherto adopted as above described.

I need scarcely add that it is not my intention to introduce the determination of the precipitated phosphate

into my ordinary analysis of superphosphate, nor include it in the usual determination of soluble phosphates, but only give it when especially requested, and state it separately; since, whatever its agricultural value may be (space forbids my entering upon this part of the question), it is no longer soluble phosphate, and will not obviously pass as such when a definite percentage of soluble is bargained for; its value is, however, at the same time very superior, I consider, to undecomposed, or ordinary insoluble phosphates.

There is one objection to the introduction of this constituent into the ordinary analysis of manures—viz. that it would be likely to lead to greater discrepancies than occur at present, and which, I believe, are caused far more by a want of sufficient attention and method in the details of the analysis on the part of the operator than by any defects in the method of analysis.

Finally, as regards the ordinary determination of soluble phosphates in superphosphates, I find the method of precipitation perfectly satisfactory and consistent when carefully performed, and believe it to be by far the best method; while, in point of time, it leaves nothing to be desired under proper management. I gave much attention to the uranium process some time since, but did not find it satisfactory in the case of superphosphates made from a mixture of phosphates.

ON

SOME DERIVATIVES OF TRICHLORMETHYL-SULPHON-CHLORIDE.

BY O. LOEW,

ASSISTANT IN THE CHEMICAL DEPARTMENT OF THE COLLEGE OF THE CITY OF NEW YORK.

THIS chloride, discovered by Berzelius and Marcet in 1812, was the subject of extended investigations by Kolbe. Since that time, no investigations on this compound have been made, although it possesses many interesting properties. I find that the simplest way to prepare it is the following:—300 grms. of bichromate of potassium, in pieces the size of a pea, 500 grms. of common hydrochloric acid, 200 grms. of nitric acid of the common strength, and 30 grms. of bisulphide of carbon, are mixed in a flask, filling it to one-fourth of its capacity, and loosely stoppered. It is kept cool in the beginning, and shaken from time to time. In about eight days the process is finished; in direct sunlight, only four days are required. By addition of water, the chloride and nitrate of potassium are dissolved, and there remains the insoluble trichlormethyl-sulphon-chloride. It is filtered off, washed, and pressed between sheets of filter paper.

When this chloride is dissolved in absolute alcohol, and treated with sulphuretted hydrogen, sulphur is deposited, and hydrochloric acid and another compound of an acid character remain in solution. By neutralisation with dry carbonate of sodium, the sodium-salt of this new acid remains dissolved in the alcohol, and crystallises by evaporation in shining scales.

0·469 grm. yielded 0·146 grm. of sulphate of sodium = 11·33 per cent Na.
0·236 grm. yielded 0·490 grm. AgCl = 51·37 per cent Cl.
0·511 grm. yielded 0·605 grm. of sulphate of barium = 16·24 per cent S.

The sodium-salt of the trichlormethyl-sulphurous acid requires—11·14 per cent Na; 51·95 per cent Cl; 15·56 per cent S; 15·56 per cent O; 5·81 per cent C.

To obtain the free trichlormethyl-sulphurous acid, the sodium-salt is decomposed by dilute hydrochloric acid and agitated with ether. The ether yields, by evaporation, this new acid in radiating needles. Both the acid and its salts are not of great stability; at a moderate temperature, especially when water is present, decomposition takes place, and a very offensive odour is evolved.

The formation of this acid takes place according to the following equation:—

$$\underbrace{(CCl_3)SO_2Cl}^{\text{Trichlormethyl-sulphon-chloride.}}{}^{*} + H_2S = \underbrace{(CCl_3)SOOH}_{\text{Trichlormethyl-sulphurous acid.}} + HCl + S.$$

The decomposition of this acid and its salts, by bromine and nitric acid, is very striking; the acid disappears, and new insoluble compounds are formed.

The action of bromine is expressed by the following equation:—

$$\underbrace{(CCl_3)SOOH}_{\text{Trichlormethyl-sulphurous acid.}} + Br_2 = \underbrace{(CCl_3)SO_2Br}_{\text{Trichlormethyl-sulphon-bromide.}} + HBr.$$

And the action of nitric acid—

$$\underbrace{(CCl_3)SOOH}_{\text{Trichlormethyl-sulphurous acid.}} + \underbrace{NO_2H}_{\text{Nitric acid.}} = \underbrace{(CCl_3)SO_2(NO_2)}_{\text{Trichlormethyl-sulphon-nitride.}} + H_2O.$$

The trichlormethyl-sulphon-bromide is a white crystalline body of a faint acrid smell, insoluble in water but soluble in alcohol and ether. On the application of heat a part is sublimed without change, while another part is decomposed. Ammonia dissolves it with evolution of nitrogen.

0·358 grm. yielded 0·313 sulphate of barium, corresponding to 12·01 per cent S.
0·492 grm. yielded 1·158 grms. AgCl + AgBr, and this mixture yielded, by reduction, 0·808 Ag, which proportions correspond to 30·77 per cent Br, and 40·22 per cent Cl.

The theory demands 12·19 per cent S, 40·57 per cent Cl, 30·48 per cent Br.

When trichlormethyl-sulphurous acid is brought into contact with concentrated nitric acid, a violent reaction takes place, and a blue oil is deposited which loses nitrous acid by contact with the air, and is converted into a white crystalline body, the odour of which inflames the eyes and is very suffocating when inhaled. This is the trichlormethyl-sulphon-nitride, especially interesting in this, that a nitride of an organic sulph-acid has been hitherto unknown. It is insoluble in water, soluble in ether and alcohol. Water added to the alcoholic solution precipitates it unchanged. It does not melt in boiling water, but is volatilised with the steam. Ammonia dissolves it slowly, with decomposition: alcoholic solution of caustic potassa decomposes it quickly. When it is treated with zinc and hydrochloric acid, it disappears, and is converted into sulphydrate of methyl and ammonia—

$$\underbrace{(CCl_3)SO_2(NO_2)}_{\text{Trichlormethyl-sulphon-nitride.}} + 18H = \underbrace{CH_3SH}_{\text{Sulphydrate of methyl.}} + H_4NCl + 2HCl + 4H_2O$$

0·5285 grm. yielded 0.532 sulphate of barium and 0·973 AgCl, corresponding to 13·83 per cent S and 46·12 per cent Cl.

* C=12 S=32 O=16.

Theory demands 14·00 per cent S and 46·61 per cent Cl.

On treating trichlormethyl-sulphon-chloride with ammonia, trichlormethyl-sulphurous acid is formed in an unexpected manner, nitrogen is evolved, and the chloride is slowly dissolved. On evaporation, broad tabular crystals are obtained. In the mother liquor, their remains chloride of ammonium, some sulphate of ammonium, and a certain quantity of this new compound. The crystals must be re-crystallised with great care, because, at a moderate temperature, an acid reaction sets in and a partial decomposition begins. These crystals show, with bromine, as well as with nitric acid, the formation of the above-mentioned bromide and nitride. The action of the nitric acid is extremely violent.

By mixing with diluted hydrochloric acid, and agitating with ether, the above-mentioned trichlormethyl-sulphurous acid is obtained.

0·431 grm. yielded 0·911 grm. AgCl=52·24 per cent Cl.

0·668 grm. yielded 0·725 ammonio-chloride of platinum =6·80 per cent N.

0·753 grm. yielded 0·894 grm. sulphate of barium=16·23 per cent S.

Theory demands 53·11 per cent Cl, 6·98 per cent N, 15·96 per cent S.

The crystals are, therefore, the ammonium salt of the trichlormethyl-sulphurous acid, and their formation can be expressed by the following equation:—

$$\underbrace{3[(CCl_3)SO_4Cl]}_{\text{Trichlormethyl-sulphon-chloride.}} + 8H_3N = \underbrace{3[(CCl_3)SO_2H_4N]}_{\text{Trichlormethyl-sulphite of ammonium.}} + 2N + 3H_4NCl$$

On treating trichlormethyl-sulphon-chloride with cyanide of potassium, evolution of cyanogen and hydrocyanic acid takes place, and the potassium salt of trichlormethyl-sulphurous acid is formed—

$$(CCl_3)SO_2Cl + 2KCy = (CCl_3)SOOK + KCl + 2Cy.$$

But, when the solution is hot and very concentrated, there is, also, another derivative of this acid formed, one atom of Cl being replaced by one atom of OH—

$$(CCl_3)SOOK + H_2O = (CCl_2OH)SOOK + HCl,$$

which latter decomposes another part of the cyanide of potassium.

A glance at the following formulæ will show the relation between these new bodies and several others already known:—

Trichlormethyl-sulphon-chloride $(CCl_3)SO_2Cl$ (Kolbe).
Trichlormethyl-sulphon-bromide $(CCl_3)SO_2Br$.
Trichlormethyl-sulphon-nitride $(CCl_3)SO_2(NO_2)$.
Trichlormethyl-sulphuric acid $(CCl_3)SO_3OH$ (Kolbe).
Trichlormethyl-sulphur*ous* acid $(CCl_3)SOOH$.
Methylsulphur*ic* acid $(CH_3)SO_3OH$ (Kolbe).
Methyl-sulphur*ous* acid $(CH_3)SOOH$ (Hobson).

—*American Journal of Science.*

ARTIFICIAL PRODUCTION OF ICE.

BY. P. H. VANDER WEYDE, M.D.

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MEANS OF ATION OF THE AMOUNT WHICH CAN BE PRODUCED
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appears to MACHINE.
circumstances

of ice produced by an ice machine, purposes, give eans of an exhaust or condensing air- a method I have y steam power, is easily determined, theoretically, from the amount of coal burned in the furnace of the steam boiler. It has been proved that the combustion of one pound of anthracite coal produces, in round numbers, 14,000 units of heat, and that in order to freeze water of 72° Fahr., it is necessary to abstract, besides 40° of sensible heat, 140° of latent heat—together 180°—which, for one pound of water is, of course, equivalent to 180 units of heat. As this number of the units is the eightieth part of the 14,000 units produced by the combustion of one pound of coal, it is clear that the heat produced by the combustion of one ton of coal is equivalent to the heat to be abstracted from 80 tons of water of 72°, in order to change it into ice.

But in practice we find here exactly the same state of affairs as is the case with the steam engine. Theoretically, a steam engine ought to produce at least 700 units of force (foot-pounds) for every unit of heat consumed; in practice, good machinery only produces from about 70 to 100 foot-pounds, from about one-tenth to one-seventh part of the theoretical amount. In the best ice machines thus far constructed, instead of freezing 80 tons of water, for every ton of coal consumed, only from about 8 to 11 tons of ice are produced, also, from one-tenth to one-seventh part of the theoretical amount, proving, thus, the remarkable fact, that in both the steam engine and the ice machine, exactly the same relation exists between the theoretically calculated effects and the practical results.

As, however, all the best ice machines accomplish the conversion of the heat of the fuel into the freezing operation by the intervention of a steam engine, the fact that they practically produce only from one-tenth to one-seventh of the amount of the cold they theoretically should produce, is solely due to the other fact, that the steam engine itself practically produces only from one-tenth to one-seventh of the amount of power which would be strictly equivalent to the number of heat units consumed. It must not be lost sight of that it is only the power of the steam engine which generates the cold in the freezing machines, and that, therefore, improvements in the steam engine, which bring its practical results nearer to the theoretical standard, will at once exert their influence on the amount of ice the ice machines can produce, and, consequently, also on the cost of the ice manufactured in these machines.

Moreover, it appears that the kind of freezing machines in question, which convert power into cold, notwithstanding they are yet in their infancy, have already attained such a degree of excellence, that they are ahead of that class of machines which convert heat into power, either by steam, hot air, or any other possible means, as it is proved that they produce the full theoretical equivalent of cold (negative heat) for the number of foot-pounds employed; namely, cooling one pound of water one degree for a power equivalent to 700 pounds, descending one foot, which, expressed in the adopted scientific manner, is one unit of negative heat for every 700 foot-pounds consumed.—*Scientific American.*

ON A

NEW SOURCE OF THE FIRST TERMS OF THE FATTY ACIDS,

AMONGST OTHERS OF PROPIONIC ACID.

BY M. BARRE.

THE dry distillation of wood produces a very acid liquid,

from which acetic acid is extracted in large quantities. The general mode of purifying the latter is to saturate the liquid with carbonate of soda, when concentration produces crystallised acetate of soda and mother liquors. These latter diffuse a strong smell of molasses. When a certain degree of concentration has been reached, the crystals cease to form, and, if evaporation be continued, they assume a confused and hygrometric mass. This latter has been the subject of my experiments. On treatment with sulphuric acid, it decomposed, forming two liquid films, which were mingled into one by the addition of water. Instead of separating these acids by fractional distillation, I operated upon their ethers, first separating them into volatile portions—

I.	Between	55°	and	58°.
II.	"	74°	"	77°.
III.	"	95°	"	98°.
IV.	"	114°	"	119°.
V.	"	133°	"	136°.
VI.	"	162°	"	165°.

and then saponifying with baryta.

I. The baryta salt produced by the ether boiling at 55° or 58°, being heated with monohydrated sulphuric acid, disengaged pure oxide of carbon. This salt reduced nitrate of silver at the boiling point; formed with perchloride of mercury a white precipitate of protochloride, &c.; and it presented the crystallographic characteristics of formiate of baryta. The ether produced was therefore nearly pure ethylformic ether.

II. The baryta salt No. 2 was acetate, as might be foreseen.

III. Baryta salt No. 3, after purification by successive crystallisations, assumed the form of perfectly defined oblique prisms. The dry salt remained unaltered in the air. Its solution, left in contact with the atmosphere, evolved a slight odour, which proved the commencement of decomposition. When dried at 100°, it decomposed slowly, losing its water of crystallisation, and changed into a salt insoluble in water. It was impossible to obtain a sensibly-pure salt, except by evaporation at a very low temperature in a receiver whose atmosphere had been dried by sulphuric acid. Analysis gave 50·7 of baryta per cent of the salt. The propionate of baryta, according to the known formula, $C_6H_5BaO_4.HO$, contains 50·7 per cent of baryta.

The lead-salt, dried at 110°, yielded a syrupy, transparent, non-crystallisable mass.

IV. Baryta salt, No. 4, took the form of flattened prisms, melting below 100°. On analysis, it yielded 44·0 per cent of baryta; the butyrate of baryta, $C_8H_7BaO_4.2HO$, contains 44·6. This salt, when treated by chlorhydric acid and chloride of calcium, decomposes, and leaves a film of butyric acid floating on the surface of the liquid. Treated with a mixture of alcohol and sulphuric acid, it forms ethyl-butyric ether, having the characteristic smell of pineapple.

V. Ether, No. 5, treated like the preceding, gives a salt which crystallises in thin flakes which effloresce quickly on contact with the air. The dry crystals, finely powdered and thrown into water, perform rapid gyrations.

When again dissolved in water and treated with sulphuric acid, an acid is formed, insoluble in water, distilling between 172° and 178°; this is valerianic acid.

VI. Baryta salt, No. 6, was crystallisable, but with difficulty. Its solution, treated with sulphuric acid, sets free a liquid acid lighter than water, but slightly soluble in the cold, soluble when warmed, soluble in every proportion in alcohol, distilling at from 198° to 205°. When saturated by a standard solution of caustic baryta, its equivalent was found to be 118·1, whilst that of caproic acid is 116. The difference of the equivalent is owing to the presence of a small quantity of acid boiling at a higher temperature, which hinders the crystallisation of the caproate.

On examining the relative proportions of these acids, formic acid is found to occur in small quantities only. Acetic acid is most abundant, the relative proportion of each diminishing as it rises in the series.

Propionic acid, whose soda-salt is very soluble in water, is found thus concentrated in the preparation of acetate of soda. The mother liquors, which contain a large quantity, might become an abundant source of its production, which has hitherto been attended with difficulty. The transformation of soda-salt into ethylic ether allows of complete purification.

This series of homologous bodies produced by a single reaction is dependent upon a general law in organic chemistry, that of simultaneous production; either in the order of analysis, the homologous bodies being produced by successive divisions, or in the order of synthesis, being formed inversely by successive additions. —*Comptes Rendus*, vol. lxviii., p. 1222.

ON A NEW REACTION OF PHENOL.

BY C. CRUMP.

If fragments of caustic potash be added to a solution of phenol in chloroform, the potash becomes covered with a rose-coloured coat, which gradually dissolves in the liquid. Considerable heat is produced, and the action goes on rapidly until the mixture which at first was red has become brown and thick. It then slackens, but may be renewed by a gentle heat, until potash has been added equal in quantity to about three times the weight of the phenol.

The final product of the reaction is a brown amorphous mass, soluble in alkaline liquids, and precipitated therefrom by acids. It seems to be a mixture of two substances, differing in solubility in alkalies and in their behaviour with strong sulphuric acid.

The first substance dissolves very easily in carbonate of potash or soda, less readily in strong sulphuric acid. From the latter solution a precipitate is thrown down by water, which behaves with alkalies like rosolic acid.

The second substance dissolves less freely in alkalies, very easily in strong sulphuric acid, forming a brown liquid from which nothing is precipitated on dilution. With tetrachloride of carbon instead of chloroform no action takes place in the cold; at 100° C. the liquid assumes the colour of rosolic acid.

When creosote from wood-tar is treated with chloroform and caustic potash, a reaction takes place very similar to that with phenol, but the product of the reaction is quite different, forming with sulphuric acid a deep crimson solution, from which a dingy green precipitate is thrown down by dilution. Moreover, the substances produced from phenol in alkaline solution colour silk or wool brown, while those from creosote have no colouring power.

ON SPIRIT MADE FROM RICE.

BY JAMES BELL, ESQ.

There has always been a difficulty experienced in

producing from rice a spirit free from a pungent odour. An impression prevailed that the pungency was due to the presence of some compound ether generated during the process of fermentation; but how or why it was produced in the fermentation of a saccharine extract prepared from rice, and not in that obtained in the ordinary way from other materials, was a problem which appeared difficult of solution.

In the course of manufacture of spirit from rice, sulphuric acid is the agent employed for converting the starch of the rice into glucose, and this process is conducted in a close wooden vessel under steam pressure at a temperature ranging from 216° to 230° Fahr. It has been observed that when the process of saccharisation was conducted at a temperature approaching 230°, the spirit obtained was more pungent than if the lower temperature had been observed. It has also been remarked that the pungency of the spirit was less in proportion as the rice was purified or freed from the husk.

Being desirous to investigate this subject, I undertook the examination of a sample of rice spirit which was placed at my disposal, and which had been made from rice that had been only partially freed from the husk, and though it appeared that the temperature during the process of saccharisation was maintained at about 216° Fahr., the spirit was very pungent.

The spirit was found, on the application of a slight heat, to freely reduce ammoniacal nitrate of silver, but without depositing the metal in a specular form; and a very small quantity sufficed to instantly decompose a solution of a permanganate.

When a portion of the spirit was treated in the cold with caustic potash and allowed to stand for a few hours, the pungency rapidly disappeared, and there was simultaneously produced a dark brown resinous substance soluble in alcohol and ether. The spirit recovered by distillation from the alcoholic alkaline solution was free from acrid odour, and gave the normal reaction with the mercury compounds for ethylic alcohol.

The addition of a very small quantity of the acid sulphite of sodium to the spirit, rapidly destroyed the pungent odour, and the alcohol obtained afterwards by distillation was unobjectionable in quality.

These reactions, it will be seen, pointed directly to the presence of an aldehyde, and in order to identify it, a portion of the spirit was introduced into a stoppered bottle, and treated in the cold with moist oxide of silver and left in contact therewith for several days. At the end of this time, there was a slight deposit of the metal on the glass, as well as other evidence that a quantity of the oxide had been reduced. To obtain the oxidised product, the excess of oxide of silver was removed by filtration and the silver salt in solution exactly decomposed with hydrochloric acid. The precipitate of chloride of silver was then filtered off, and the liberated acid neutralised with baryta and the spirit distilled. The distillate obtained was destitute of pungent odour, and the spirit was commercially pure.

The baryta salt which formed the residue in the retort was decomposed with sulphuric acid, and the liberated organic acid separated from the insoluble sulphate by distillation. The acid thus obtained proved to be acrylic, which had been produced from acrylic aldehyde by oxidation, and consequently, it was to the presence of this aldehyde that the pungent odour of the spirit was due.

There can hardly be a doubt that it is during the process of saccharisation that the fatty substances contained in the rice are decomposed; and that the acrolein is immediately thereupon produced by the action of the sulphuric acid upon the glycerine; and this view would seem to be borne out by the fact stated above, that a variation in the steam pressure in conducting the process of saccharisation affected the quantity of the acrolein produced.

It is well known that fats in a state of emulsion are in a condition to be readily acted upon by chemical reagents and to be decomposed, and it is not improbable that the conditions in this case are favourable to the action of the sulphuric acid upon the fatty substances in the rice, and in effecting their decomposition.

A sample of the rice from which the spirit was prepared was found to contain 0·62 per cent of fats, and assuming that the whole of the glycerine contained therein was converted into acrylic aldehyde, and that 65 per cent of starch was actually utilised in the production of ethylic alcohol, every thousand grains of the latter would contain one grain and a-half of the aldehyde.

The fact has long been known that rice spirit contained some compound which possessed the property, like acetone, of dissolving and keeping in solution certain compounds of mercury which are insoluble in pure alcohol and in water; and that before the absence of wood naphtha in rice spirit could be established by the ordinary chemical tests, it was necessary to distil the spirit once or twice from caustic potash.

The sample of rice spirit in question possessed the property of preventing the precipitation of the mercury compounds in an eminent degree, but the spirit after the complete separation of the acrylic aldehyde gave the normal reaction for pure alcohol.

To test the solvent power of acrolein for the mercury compounds, a small quantity of the aldehyde was prepared, and it was found to possess the property of preventing the precipitation of the ammonium compound of iodide of mercury in an alkaline solution, to nearly the same extent as acetone; and a very minute quantity of it was sufficient to impart a pungent odour to pure alcohol, simlar to that possessed by the rice spirit.

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

The object of the present series of articles is to place my own practice before beginners in microscopical science; for although there are a vast number of existing works on the microscope, many of them are of a popular nature and addressed to those who seek in the microscope a means of recreation rather than of scientific research. My wish is to supply simple and practical directions to aid the student, giving very much in detail such processes as are but little mentioned in books, and which are more usually learned by seeing the instrument in the hands of an experienced person; but as this is an advantage not accessible to every one, it would seem that there is still a want, which it is my hope that this and succeeding papers will help to supply, and prepare the student to consult with profit more elaborate treatises.

I have thought proper, therefore, to devote this

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1862.

article to the consideration of the instrument we have to work with. No workman is any the worse for a knowledge of the contents of his tool-chest; in fact, he will be far better qualified for making use of the appliances he possesses by knowing their construction.

Microscopes vary much in their details of construction, each maker having an instrument for which he claims its own especial merit. For convenience sake, the general plan of structure may be described as consisting of a tube containing the optical portion, capable of a sufficient range of motion to and from a support for the object to be examined, known as the stage, beneath which is placed a mirror, provided with the necessary adjustments for reflecting light upwards through the aperture in the stage.

The plans employed for supporting the tube containing the lenses, or "body," are two in number; in one, that adopted by Messrs. Beck and a few other makers, the body is supported by the greater part of its length, and runs in groove of peculiar form, which effectually prevents the detrimental movement known as "twist." In the other mode, the one used by Messrs. Ross, Powell and Leland, and the majority of opticians, the body is attached to the extremity of the cross-arm, the rack work moving up and down in a tube attached to the trunnions which carry the instrument between the two uprights connected with its base. This last plan of construction involves the use of a greater weight of metal and a more careful disposition of it to secure stability than where the body is supported in the former manner, but when skilfully made there is no practical objection to its employment.

Dr. Carpenter speaks highly of the first mode, which is also approved of by Dr. Bowerbank: my experience is decidedly in its favour, my own instrument so constructed having been exposed to more than ten years' severe wear, and having had no substantial repairs during that period.

The part of the microscope I wish to direct attention to in the first instance, is the body and its contents. A combination of lenses called the object glass is screwed to the bottom of the tube, and another called the eye-piece, is placed at the top. For the sake of simplicity, the binocular arrangement will be for the present omitted, the instrument being supposed to have but a single body. In order that the use of the glasses contained in this tube may be understood, I must direct attention in the first place to some of the properties of light.

A *ray* of light, which is a very arbitrary term, may be considered, for the present purpose, as a small cylinder of light—a thing which has no real existence in nature, but will serve well for the purpose of demonstration. It is very much what the line is in mathematics.

Should this ray of light fall upon a polished surface which is not capable of allowing it to go through, or, in other words, an opaque polished surface like a bright plate of metal, *c*, *d* (Fig. 1), if the ray of light, *b*, *a*, falls upon that surface perpendicularly, it will be sent back by the same course through which it came down. On the contrary, should the ray of light *e*, *a*, fall obliquely, it will be reflected at an angle, *b*, *a*, *f*, equal to that *e*, *a*, *b*, at which it fell upon the reflecting medium. This angle of incidence, *e*, *a*, *b*, will be equal to the angle of reflection, *b*, *a*, *f*. Now this principle is made use of in our commonest means of illumination,—the mirror under the stage by which the light from a lamp or other source of light at one side or in front of the microscope, or in any other convenient place, is directed through the axis of the instrument. In the subsequent papers I shall say more about the application of the reflective principle. This is the only instance to be noticed at present.

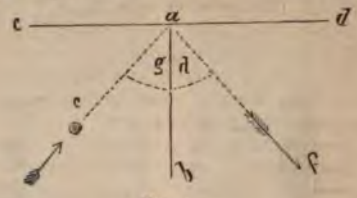

Fig. 1.

Now, supposing that the ray of light falls upon a transparent material (a plate of glass, for example, a substance more dense than air), should the ray, *c*, *d*, fall upon this plate of glass, *a*, *b* (Fig. 2), perpendicularly,

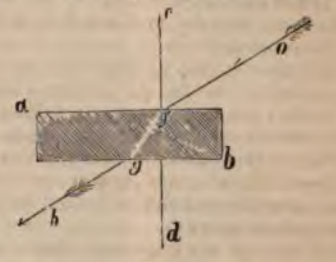

Fig. 2.

it passes it straight through without any alteration taking place; but should the ray of light, *e*, *f*, fall obliquely, it will no longer pass through in the same direction, but will be bent towards the perpendicular, *c*, *d*, in a greater or less degree according to the density of the medium, as at *f*, *g*, and is bent again upon its emergence into the rarer medium at *g*, towards *h*.

The amount of "refraction," as this bending is called, would be much less with water than it would be with glass, and it would be greatest of all in the diamond, other substances refracting in intermediate degrees.

The effect of refraction is familiarly illustrated by the well-known phenomenon of objects immersed in water appearing to be nearer the surface than they really are, a pool appearing to be only three or four feet deep, when in reality it is nearer six or eight. This may be readily demonstrated by placing a stick or other object in a basin of water (Fig. 3); the stick will

Fig. 3.

appear bent where it enters the water; a coin or other object will appear to be at a much less depth than it actually is.

It is owing to refraction that we are able to make

[English Edition, Vol. XX., No. 513, pages 145, 146.]

use of lenses, which give us the power of bending rays of light and turning them about in any way that may be required.

Lenses are circular pieces of glass or other transparent material capable of refracting light, and having curved surfaces, either convex or concave.

The action of a lens upon a ray of light will be best understood by reference to Fig. 4. For the sake of

Fig. 4.

simplicity the dotted curved lines representing the section of the lenses may be considered as straight lines, as shown in the diagram.

It has been shown (Fig. 2) that when a ray falls obliquely it is refracted, but that when it falls at right angles with the refracting medium it suffers no refraction. The central ray in both A and B passes straight through without refraction; in A the inclination of the surfaces is such that the rays passing above and below the centre line converge at a point called the focus. The lens, B, being thickest at the margin, the effect is just the reverse; the rays are dispersed, and do not come to a focus but diverge, as if they proceeded from a point on the opposite side of the lens, called the virtual focus. These concave lenses do not magnify, but are used in microscopes and other optical instruments, for purposes to be hereafter mentioned: the most familiar instances to be cited of their use are as the eye-glass of an opera-glass or Galilean telescope, and as spectacles for short-sighted persons.

Lenses may be made with one side worked to a plane surface and the other either convex or concave, such lenses are known as plano-convex and plano-concave lenses; their respective powers are about half those of lenses of similar and double curvatures. There are also lenses convex on one surface, and concave on the other; these are called meniscus lenses; the curves may be so proportioned that they have either the power of convex or concave lenses, according as they are thickest in the middle or at the edge; they have, moreover, some properties peculiar to themselves which are turned to good account by skilful opticians.

The formation of images is one of the most valuable properties of convex lenses, and one taken advantage of in the construction of optical instruments. If a convex lens is held at the distance of its focal length in front of a sheet of paper or other white surface, an inverted picture more or less distinct will be seen of objects that may be before it, such as a window or candle flame. This is illustrated by the diagram Fig. 5, repre-

Fig. 5.

senting a candle flame on the left hand, from the apex of which two rays diverge, the lower one reaching the lower edge of the lens and the upper one its centre. Rays proceed from each point of the flame to every part of the surface of the lens, but, for the sake of clearness, only two are here represented. After passing through the lens they converge; the same takes place with the rays proceeding from the lower part of the flame, which also pass through the lens. The result is the formation of an inverted image, the size of which and its distance from the lens are dependent upon the distance of the object and the focal length of the lens.

The greater the distance of the object, or "anterior focus," the shorter will be the distance of the image, or "posterior focus." The commonest example may be taken from the operations of the photographer, who, if he wants to take a small portrait, will place the sitter at a great distance from the camera, if, on the contrary, he desires a large figure, he will bring his model nearer; in the former case the posterior focus of the camera will be shorter than in the latter, which is shown by the camera requiring to be lengthened when the model is brought near to it.

Besides the use of lenses to form images, they are also employed as magnifiers, and constitute the simplest form of microscope. Most naturalists and microscopists are provided with some little contrivance of this kind either attached to the watch chain or carried in the pocket,—either one or more lenses suitably mounted, or the Stanhope lens. In all these simple microscopes no image is formed, so that the principle upon which a magnified view is obtained is different. The idea of the magnitude of an object is formed entirely by the space which it occupies upon the retina of the eye. It is quite irrespective of its actual size; or, to express it in mathematical language, an object is large or small in proportion as it subtends a great or small angle with respect to the eye.

The eye has a certain power of adjusting itself to view objects at different distances, but there is a limit to the distance of distinct vision. It varies from five to ten inches in different persons. An object cannot be distinctly seen nearer than either one or other of these distances, or some intermediate point. Now optical science supplies a means of overcoming this difficulty. An object apparently enlarged by being brought nearer to the eye, becomes indistinct, because the pencils of rays proceeding from it diverge too much to be brought to a focus on the retina by the lens of the eye.

The optical instrument most closely resembling the eye is the camera obscura. When the rack is run out to its full extent and the body is drawn out as far as it will go, and the object is still too near to be focussed distinctly, the position is precisely that of the eye with an object too close to it for distinct vision.

The remedy with the camera, supposing that no more focussing space could be obtained, would be to shorten the focus of the lens; that is, use one of greater refractive power. The same thing must be done in the case of indistinct vision, by interposing a convex lens and so increasing the convergent power of the lens of the eye; the object, hitherto too near the eye, *a*, *b*, is thus rendered visible and clearly defined, but with this remarkable difference, that it appears not to be the image of the object placed near the eye, but of a larger object, A, B, at the distance of distinct vision. No crossing of the rays takes place, and consequently the image is not inverted.

The hand magnifier is an extremely useful instrument, but many persons find great trouble in using it

to advantage, especially when it is of short focus and high power. A trifling hint about its use may be of value.

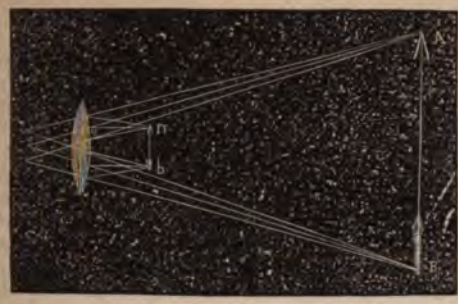

Fig. 6.

Hold the object in the left hand, either in the fingers or with forceps, and, placing the left hand against the right which is holding the lens, look through the magnifier and adjust the focus. The view is usually most distinct when the eye is in one focus of the lens and the object in the other; the two hands being held in contact move together and prevent that tremor which would be apparent, especially with high powers, if the hands were kept apart, and which unsteadiness prevents any accurate view of the object being obtained. Single lenses, when their diameter exceeds that of the pupil, possess the property of bringing light to the eye and rendering the object clearer than it would be without such assistance. This may be proved by looking at print or other suitable object in a bad light and noticing how much the magnifier aids by its light-collecting power.

Single lenses are mounted on stands of various kinds, and then they become what are called single or simple microscopes. The older observers had no other instruments. These may consist of many lenses, while the compound microscope may be made with as few as two; but then they act upon the principle that no image is formed, but the object is rendered visible at a shorter distance than it could be without optical aid. Single microscopes are still in use for dissection and other purposes where only a low power is required. And various contrivances have been adopted by which both eyes may be used and much fatigue saved in protracted operations.

The compound microscope differs from the simple instrument just mentioned in an image being formed and again magnified by being viewed with another lens or eye-piece (Fig. 7).

From what has been said before respecting the formation of images, it is evident if a lens of short focus is used and an object placed before it, the image will be formed at a great distance behind it and be much enlarged; if instead of viewing this image directly, as in the camera obscura, it is viewed with a suitable lens, another enlargement takes place. Such an instrument might be constructed with only two lenses, as in the diagram Fig. 7, A, but a microscope so made would of course be a very imperfect instrument; indeed it would in almost every point be inferior in its performance to that of a simple lens, principally because the eye lens magnifies all the imperfections of the image formed by the small lens or object-glass.

* Figs. 6, 7, 8, and 10 are taken from "The Microscope and its Revelations," by W. B. Carpenter, M.D. (Churchill).

These imperfections are chiefly caused by the spherical and chromatic aberrations of the object-glass, and also in some degree by those of the eye-piece.

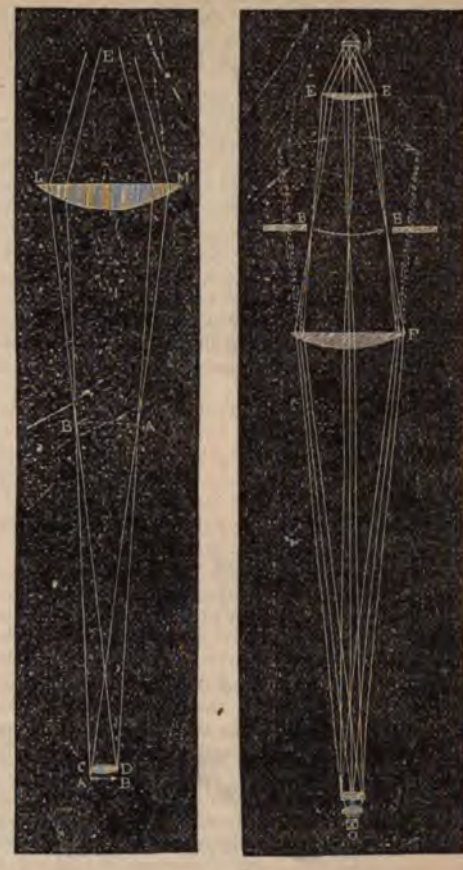

Fig. 7.

Theoretically, convex lenses bring parallel rays to a point called the focus, at a distance from the lens dependent upon the radii of their curved sides; practically, this is not the case; the rays passing through the marginal portion of the lens come to a focus at a shorter distance from it than those which pass through or near its centre (Fig. 8). Those passing through in-

Fig. 8.

termediate portions converge to some part between these two points; the result is that indistinct images are formed at various points between *r* and *f*, Fig. 8, no well-defined figure being seen anywhere. Could

lenses be made having an hyperbolic or elliptic section, the spherical aberration would be corrected, but the difficulties of making lenses of such figures are so great as to be considered impossible in practice. Spherical aberration may be lessened by reducing the aperture of the lens, by cutting off the marginal portion by means of stops or diaphragms; but any great use of this means causes a loss of light very detrimental to the performance of the instrument. Advantage may also be taken of the position in which the lens is placed and also of its figure; the spherical aberration of some lenses, such as plano-convex and meniscus, is much affected by the way they are placed, being much greater in one position than another. Much may be done by placing the glasses in their most favourable position and using suitable curves: as a striking example, take to pieces a photographic lens and observe the curious forms adopted in its construction. The details of these corrections are rather a matter for the practical optician, and are unsuitable for an elementary treatise on the microscope.

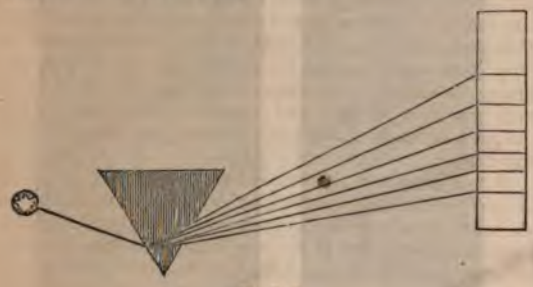

Fig. 9.*

Chromatic aberration is caused by the unequal refraction of the constituents of a ray of light. If a ray be bent by passing through a glass prism, instead of the ray appearing on the other side as white light, it will be decomposed, owing to the unequal capability of bending which the rays possess; the red ray is bent least, the yellow more, and the blue and violet most of all (Fig. 9). This also takes place when light is caused to pass through a lens (Fig. 10). The blue ray being

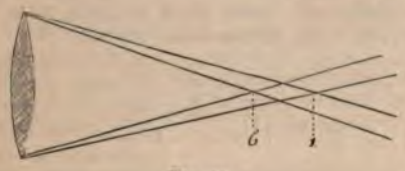

Fig. 10.

the most refrangible comes to a focus nearest to the lens at *b*; the red ray being the least refrangible will not converge until it reaches *r*; the yellow, green, etc., rays come to a focus at intermediate points, so that a series of images surrounded by fringes of their respective colours would be formed at various points between *b* and *r*, such coloured margins rendering the definition extremely defective. Chromatic aberration may be lessened by the use of stops, cutting off the marginal portion of the lens, but at the sacrifice of a great quantity of light and the impairing of some of the most valuable qualities of the glass for microscopic purposes. Fortunately, a means has been found of almost entirely correcting chromatic aberration. Different kinds of glass vary not only in their refractive power but also in the degree in which they disperse the coloured rays, and, by combining lenses of suitable forms and materials, the error of one lens is so neutralized by the opposite error of the other that the combination as a whole is nearly free from the production of colour, or becomes, as it is termed, achromatic. For the practical application of this valuable fact, we are indebted to the elder Dollond, who constructed telescopes on this principle towards the end of the last century. The object-glass of the microscope was not improved until many years afterwards.

Owing to the very divergent condition of the rays proceeding from a minute object placed near the lens of a microscope, the construction of an achromatic object-glass is much more complex than the combination employed in other optical instruments. High powers contain as many as three combinations of compound lenses placed behind each other, the careful adaptation of which requires the greatest skill on the part of the optician, and necessarily causes objectives of large aperture and great perfection to be very costly. A valuable series of papers by Mr. F. H. Wenham on the construction of object-glasses for microscopes will be found in the *Monthly Microscopical Journal*, vol. i. pp. iii., &c.

So perfectly was the correction of the chromatic and spherical aberrations effected, that it was found that even the covering of the object to be viewed with a thin plate of glass or mica rendered the image sensibly indistinct: fortunately the defect was no sooner discovered than the late Andrew Ross applied a simple remedy; some alteration was made in the disposition of the correcting media, and the front combination allowed a small range of motion backwards and forwards, which is usually regulated by a graduated collar, the use of which it will be well to explain, as, although it is to be found in most works on the microscope, it seems to be generally overlooked. Makers differ a little in the details of their arrangement for this correction, but there will always be found some mark indicating when the object-glass is corrected, for viewing an uncovered object. Focus carefully for distinct vision, with the glass so arranged, and then, taking hold of the collar, turn it round until a view is obtained of dust that may be resting on the upper surface of the cover of the slide; if the object is now focussed by the use of the fine adjustment, the correction for the thickness of the cover-glass will be found to be very perfectly made, and as the collar is usually graduated, the number may be noted on the slide for future use, as it is constant with the same object and eye-piece, and also for the same thickness of cover-glass.

The eye-piece usually employed in the microscope in combination with achromatic object-glasses is that invented by Huyghens, a Dutch astronomer (Fig. 7), and consists of two plano-covex lenses (E E and F F with their plane sides towards the eye; this eye-piece, although not achromatic, when used with object-glasses slightly "over-corrected," renders the instrument achromatic as a whole. The optical principles involved are far too complicated to find a place in the present paper.

The power of the instrument may be greatly varied by using a series of eye-pieces of different power, and if the corrections of the object-glass are perfect, and its angular aperture sufficient to admit a large amou

* Hardwich's "Photographic Chemistry," p. 173 (Churchill).

of light, great advantage may be derived from the use of a short or "deep" eye-piece; but as the magnifying power of the eye-piece exaggerates every defect of the image, it is only with good object-glasses that this means of increasing the power is available. A very deep eye-piece is of value in testing the quality of an objective, as it causes defects which may not be apparent with lower powers to become very marked.

The power of the instrument is greatly influenced by the length of the tube or body, and were it not for the inconvenience of excessive length, this would probably be the least objectionable way of increasing the magnifying power, but a very long tube renders manipulation difficult, on account of its removing the hands to an uncomfortable distance from the stage and illuminating apparatus. Most microscopes have a sliding tube in the body known as the draw-tube, by which the length can be increased to the extent of four or six inches at pleasure.

(To be continued.)

PRELIMINARY NOTE ON A NEW CORNISH MINERAL.

BY PROFESSOR CHURCH, M.A.

During a recent visit to Cornwall, I purchased from Mr. Talling, of Lostwithiel, some specimens of a dark brown, amorphous mineral which had been recently found by him. These prove to be an unrecognised silicate of iron. Here are, in brief, the characters of the new species:—

Hardness, 2.75; specific gravity, 1·74. Amorphous, reniform, fissured, dark brown. Streak, pale rust-brown. Fragile; fracture, irregular conchoidal. Blowpipe—in closed tube, much water, having slight permanent acid reaction; on charcoal, decrepitates, and becomes black; partially fuses in outer flame to a black bead, in inner to a red-brown. Boiled in acids, leaves a siliceous skeleton.

This mineral gives, on analysis, the following percentages:—

Water	10·51
Silica	36·39
Ferric oxide	52·94
	99·85

The mineral also contains 0·82 per cent of P_2O_5, and traces of magnesia. It loses 29 per cent of water *in vacuo*, and only 0·54 per cent more at 100.° The analyses were made with the substance dried at 100° C.

The numbers above agree with the expression—

$$5Fe_2O_3,9SiO_2,8H_2O,$$

which demands 53·74 per cent Fe_2O_3, 36·58 per cent SiO_2, and 9·68 per cent H_2O; but many considerations point to the simpler formula, $Fe_2O_3, 2SiO_2, 2H_2O$, which demands—

	Theory.	Experiment.
$2H_2O$	11·39	10·51
$2SiO_2$	37·98	36·39
Fe_2O_3	50·63	52·94
	100·00	99·85

The chief discrepancy between theory and experiment concerns the iron, which is greater than it should be. This arises from three causes—(1) Traces of the iron exists as a ferrous salt in the mineral; (2) the percentage of Fe_2O_3 includes 0·82 per cent of P_2O_5; (3) it is difficult to separate the haematitic matrix from every portion of the mineral taken for analysis. The causes which have raised the iron percentage have also been amongst those which have reduced the silica and water percentages below their theoretical amounts.

The new mineral, which I shall name on a future occasion, has been mistaken for beraunite: it accompanies pyrite, chalybite, quartz, black haematite, and cronstedtite.

Royal Agricultural College, Cirencester,
September 18th, 1869.

ON THE SUPPOSED ACTION OF LIGHT ON COMBUSTION.*

BY CHARLES TOMLINSON, F.R.S., F.C.S.

The popular idea that "light puts out the fire," is so fixed, that probably no conclusions drawn from actual experiment are likely to disturb it, especially if they be adverse to the notion. It is a matter of daily experience, people say, that, if the fire is nearly out, and you put a screen before it, or draw down the blind, or close the window-shutters, it will immediately begin to revive. It is generally forgotten that a fire that looks dull, or "out," in a well lighted room, will appear to be in tolerable condition in the same room when darkened. only requires to be "put together" to make it burn up, and it might have been done so just as well in the light.

Experiments on this subject are not easy to make, on account of the many disturbing causes. In an old volume of the "Annals of Philosophy," is an account of some experiments by Dr. M'Keever, who took two portions of green wax taper, each weighing 10 grains, and ignited both at the same moment. One piece was placed in a dark room, at 67° F.; the other was exposed to broad sunshine, at 78° F.

In five minutes { The taper in sunshine lost..... 8¼ grs.
" darkened room lost. 9¼ "

The taper, divided into inches, was also burnt in the coloured portions of the solar spectrum, when it was found that the time required to burn two inches of taper varied as follows:—

	Mins.	Secs.
In the red ray it took	8	0
In the green	8	20
In the violet	8	39
In the verge of the violet	8	57

The conclusion is, that the solar rays, in proportion to their intensity, have the power of retarding, to a considerable extent, the process of combustion; and it is supposed that the chemical rays act, in some way, on the portion of oxygen about to combine with the fuel, so as to delay, if not prevent, combination.

Supposing, in these experiments, the taper was so uniform, that one inch contained precisely the same quantity of matter as another inch, the time occupied in burning was too short to justify so important a conclusion as Dr. M'Keever arrived at, whether the results were taken by measure or by weight.

Everyone engaged in photometrical observations must be aware of the difficulty of getting rid of disturbing causes and perplexing results. In comparing candles of the same make, the light is affected, both in quantity and economy, by a number of small circumstances, such as the warmth of the room, the existence of slight currents of air, the extent to which the wick

* Read before the British Association, Exeter Meeting, Section B.

curls over in burning, and so on. In testing the quality of gas, the standard candle defined by Act of Parliament is a sperm candle of six to the pound, burning at the rate of 120 grains per hour. From such a standard, we get the terms "twelve candle gas," "fourteen candle gas," &c. Mr. Sugg, in his "Gas Manipulation," has pointed out some of the difficulties in obtaining a uniform standard candle. The wick does not always contain the same number of strands; they are not all twisted to the same degree of hardness; the so-called sperm may vary in composition—one candle containing a little more wax than another, or variable quantities of stearine or of paraffin; the candle may have been kept in store a long or a short time; the temperature of the store-room may have varied considerably, and the temperature of the room in which it was burnt may have been high or low. All these circumstances affect the rate of combustion, and the illuminating power of candles, irrespective of the action of light, if such action really exist.

I have lately had a good opportunity of testing this action at the works of Price's Patent Candle Company, at Battersea. Under the direction of Mr. Hatcher, the accomplished chemist of the Company, the greatest possible care is taken to ensure identity of composition and illuminating power in candles of the same name. There has lately been an extensive series of experiments on the photometrical value of sperm candles, during which, at my request, Mr. Hatcher was good enough to note the rate of combustion of such candles in a darkened room, and also in broad daylight, and even in sunshine.

In the first observation, three hard and three soft candles were burned, each for four hours, in a dark closet. A similar set of candles, taken from one and the same filling, were burned, during the same time, in open daylight, partly in sunlight. The average consumption per hour of each candle was as follows:—

Sperm, in the dark		134 grs.
Ditto, in the light		141 "
No. 2 composites	In the dark	133 grs.
	In the light	140 "

It must be noticed that the temperature in the light was 72°, and in the dark 71°; moreover, in the light there was a much greater motion of the air than in the dark closet. Both these circumstances would operate in producing a larger consumption of candle.

In a second trial with No. 2 composites, the results were:—

In the dark	140 grs. each candle.
In the light	134 " "

In a third trial, also with No. 2 composites, the results were:—

In the dark	131
In the light	129

In these two trials, the flames were protected, as far as possible, from currents of air; and in a third trial, the temperature, both in the light and in the dark, was nearly equal.

The fourth trial was made on a bright, sunshiny day, with hard sperm candles, which are less affected by variations of temperature than the composites. The results were:—

In the dark (temperature, 81°), 544 grs., or 136 grs. per hour.
In the light (temperature, 84°), 567 grs., or 142 grs. per hour nearly.

It is evident that, in this case, the increase of temperature caused by the bright sunshine led to an increased consumption of material.

It will be seen that, in the first and fourth trials, there is a greater consumption of material in the light than in the dark; and in the second and third trials, the consumption is greater in the dark than in the light; but, in any case, the difference is so small—amounting only to from 2 to 7 grains per hour—that it may fairly be referred to accidental circumstances, such as difference in temperature, in currents of air, and in the composition and make of the candles; the final conclusion to which I am led being that the direct light of the sun, or the diffused light of the day, has no action on the rate of burning or in retarding the combustion of an ordinary candle.

SOME EXPERIMENTS WITH THE GREAT INDUCTION COIL AT THE ROYAL POLYTECHNIC.*

BY JOHN HENRY PEPPER, F.C.S., ASSOC. INST. C.E.

The Large Induction Coil.

The length of the coil from end to end is 9 feet 10 inches, and the diameter 2 feet; the whole is cased in ebonite; it stands on two strong pillars covered with ebonite, the feet of the pillars being of a diameter of 22 inches. The ebonite tubes, &c. are the largest ever constructed by the Silver Town Works.

The total weight of the great coil is 15 cwts., that of the ebonite alone being 477 lbs.

The primary wire is made of copper of the highest conductivity, and weighs 145 lbs.; the diameter of this wire is 0·0925 of an inch, and the length 3770 yards. The number of revolutions of the primary wire round the core of soft iron is 6000, its arrangement being 3, 6, and 12 strands.

The total resistance of the primary is 2·201400 British Association units, and the resistances of the primary conductors are respectively—For three strands, 0·733800 B.A.U.; six, 0·366945 B.A.U.; twelve, 0·1834725 B.A.U.

The primary core consists of extremely soft straight iron wires 5 feet in length, and each wire is 0·0625 of an inch in diameter. The diameter of the combined wires is 4 inches, and the weight of the core is 123 lbs.

The secondary wire is 150 miles in length; it is covered with silk throughout, and the average diameter is 0·015 of an inch.

The total weight of this wire is 606 lbs., and the resistance 33,560 B.A. units. The length of the secondary coil is 50 inches, and the insulation throughout is calculated to be 95 per cent beyond that required. The secondary wire is insulated from the primary by means of an ebonite tube of ½ an inch in thickness and 8 feet in length.

The length of the secondary coil is 54 inches, the diameter is 19 inches, and without the internal ebonite tube containing the primary wire and iron core it is a cylinder 19 inches in diameter and 6 inches thick.

The condenser, made in the usual manner with sheets of varnished paper and tinfoil, is arranged in six parts, each containing 125 superficial feet, or 750 square feet of tinfoil in the whole.

* Abstract of a paper communicated to the Royal Society, by J. P. Gassiot, F.R.S.

A large and substantially made contact breaker, detached from the great coil and worked by an independent electro-magnet, was constructed and worked very well with a comparatively moderate power of 10 or 20 large Bunsen's cells; when, however, the battery was increased to 30 or 40 cells, it became unmanageable.

A Foucault break, with the platinum amalgam and alcohol above it, was now tried, and answered very much better than the ordinary contact breaker; there was no longer any burning or destruction of the contact points, although the great power of the instrument appeared to cause continued decomposition in the water of the alcohol placed above the platinum amalgam; and every now and then the spirit was violently ejected, probably by explosion of the mixed gases taking place in the amalgam, in which they collected in bubbles; the alcohol took fire constantly, and had to be extinguished. A large and very strong glass vessel (in fact, an inverted glass cell belonging to a bichromate battery) was bored through, and the neck fitted into a cap with cement, a thick wire covered with platinum being inserted in the bottom; the platinum amalgam was poured on this, and over it a pint or more of alcohol; the contact wire was also very thick, and pointed with a thick stud of platinum, and, being attached to a spring, contact was easily made and broken. Explosions did not occur, flashes of light could be seen between the amalgam and the alcohol, and the height of the column of the latter prevented the forcible ejection of the spirit, which no longer took fire. The break was used for eight hours in a continuous series of experiments.

The Bunsen's battery used in the experiments was made with the largest porous cells that could be obtained, and each cell contained about one pint of nitric acid.

Some experiments were tried with the battery arranged for intensity, and used with the complete condenser of 750 square feet of tinfoil and 1500 square feet of paper. At first five cells were used, and these gave a spark 12 inches in length. The number of cells were gradually increased until 50 were in operation, when a spark from 28 to 29 inches in length was obtained.

In order to ascertain whether any variation in the size of the condenser would affect the length of the spark, a number of experiments were tried; and it was found that when half the condenser was used the spark increased in length up to twenty cells, but not after.

Experiments were now tried to ascertain whether any increase in the length of the spark could be obtained by arranging the battery and the primary coil for *quantity*, but no material advantage was obtained by this arrangement; even where three groups of cells were connected, a decrease in the length of the spark is observed when compared with the 45 or 50 cells arranged for intensity, the difference being as 20 to 28.

The spark obtained from the large coil is thick and flame-like in its appearance, and therefore it will be alluded to as the "flaming spark."

When the discharging point and circular plate are brought within 6 or 7 inches of each other, the flaming nature of the spark becomes still more apparent.

Two light yellow flames curving upwards appear to connect the opposite poles. If a blast of air from powerful bellows is directed against a flaming spark, the flaming portion can be blown away and increased in area, and thin wiry sparks are now seen darting through it, sometimes in one continuous stream, at another time divided into three or more sparks, all following the direction in which the flame is blown.

The flaming spark is very hot, and if passed through asbestos (supported on an insulating pillar), quickly causes the latter to become red-hot.

When powdered charcoal is shaken from a pepper-box into the flaming spark in a vertical line, and in considerable quantities, the greater part of the light is obscured, and the whole form of the flaming spark presents the appearance of a black cloud with a line of brightly ignited particles fringing the bottom parts. If the charcoal is dusted through in small quantities, each particle becomes ignited, like blowing charcoal into a hydrogen flame.

When the flaming spark is directed on to a glass plate upon which a little solution of lithium chloride is placed, the latter colours the flame upwards to the height of 3 or 4 in the most beautiful manner; and if the point of the discharge is tipped with paper, or sponge moistened with a little solution of sodium chloride, the two colours (the yellow from the salt, and the crimson from the lithium) meet each other, a neutral point being found about half-way, and thus illustrating apparently the dual character of electricity, and that + passes to − electrical, and *vice versâ*.

The flaming spark can be obtained in perfectly dry air.

Whilst passing through common air, if blown against a sheet of damp litmus-paper, the latter is rapidly changed red. In order to ascertain whether the acid product was nitric acid, the flaming spark (9 or 10 inches in length) was passed through a tube connected by a cork and bent tube with a bottle containing distilled water, from which another tube passed to the air-pump; on drawing the air slowly over the spark, and passing the former into the bottle, nitric acid was obtained in large quantities, so much so that it could be detected by the smell and taste as well as by the ordinary tests. The popular notion that nitric acid is always produced during a thunder-storm would therefore appear to be correct. To determine the effect of a cooling surface on the flaming spark, a hole 1¼ inches in diameter was bored through a thick block of Wenham Lake ice, and the spark passed through the air in the tube of ice; no change took place, and the spark was still a flaming one.

When the spark was received on the ice, it lost its flaming character, and became thin and wiry, spreading out in all directions.

If the discharging wires were tipped with ice, the spark was always flaming when any thickness of air intervened between them. Even over the ice, if the spark passed a fraction of an inch above the surface, it was always a flaming one, but changed to the thin spark when the point of the discharging wire was thrust into the ice.

If one of the discharging wires of the great coil is brought to the centre of a large swing looking-glass and the other wire connected with the amalgam at the back, the sparks are thin and wiry, aborescent, and very bright; the crackling noise of these discharges being quite different from that of the heavy thud or blow delivered by the flaming spark.

When the discharging-wire is brought close to the flame of the looking-glass, or if a sufficient thickness of air intervenes, the spark again becomes flaming; or, as sometimes occurs, if the discharging-wire is placed about 5 inches from the frame, the spark is partly

flaming and partly wiry, *i. e.*, when it impinges on the glass.

The spectrum is a continuous one with the sodium-line.

When the blast of air is used, and the wiry sparks made apparent, then the nitrogen line appears.

The flaming spark has been ascribed by some experienced observers to the incandescence of the dust in the air, and especially sodium chloride.

To ascertain whether the "flaming spark" could be obtained with a small number of cells, the large Bunsen's battery was reduced to three cells, and it was found that no appreciable spark could be produced when the whole primary wire was used with less than five cells.

By reducing the length of the primary wire, and using the four divisions separately, with five cells the spark was wiry, and varied from 4½ inches to 6½ inches; with ten cells it was wiry, and varied from 8½ to 9¾; in the latter the spark was slightly flaming. With fifteen cells the spark was slightly flaming, and varied from 10 inches to 11¾ inches. With 20 cells a flaming spark varying from 11½ inches to 12½ inches was obtained.

When the two wires from the secondary coil are placed in water, no spark is perceptible, even when the wire was brought very close together, until they touch.

If the negative wire is passed through a cork, on which a glass tube (a lamp glass) is fixed containing a depth of 5 inches of water, and the positive wire is brought within half an inch of the surface of the water in the tube, it becomes red-hot, and if drawn further away from the surface the upper part of the tube is filled with a peculiar glow or light abounding in Stokes's rays.

The experiments with the vacuum tube, and especially Gassiot's cascade, are, as might be expected, very beautiful. When a coal-gas vacuum tube of considerable diameter, and conveying the full discharge from the secondary coil, is supported over a powerful electro-magnet axially, the discharge is condensed and heat is produced.

If placed equatorially, the heat increases greatly, and when the discharge is condensed and impinges upon the sides of the glass tube, it becomes too hot to touch, and if the experiment was continued too long the tube would crack.

The enormous quantity of electricity of high tension which the coil evolves, when connected with a battery of forty cells, is shown by the rapidity with which it will charge a Leyden battery.

Under favourable circumstances, three contacts with the mercurial break will charge 40 square feet of glass.

On one occasion a series of twelve large Leyden jars arranged in cascade were discharged; the noise was great; and each time the spark (which was very condensed and brilliant) struck the metallic disk, the latter emitted a ringing sound, as if it had received a sharp blow from a small hammer.

The discharges were made from a point to a metallic disk; and when the former was positive the dense spark measured from 18½ to 18¾ inches, and fell to 8½ inches when the metallic plate was positive and the point negative.

Variations of the Leyden jar experiments were tried by connecting the coil worked by a quantity battery of 15+25 cells with six Leyden jars arranged in cascade, and the spark obtained measured 8½ inches.

The same six jars connected with the coil, when the fifty cells were arranged continuously for intensity, gave a spark of 12 inches of very great density and brilliancy.

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General Laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

Hydrostatics, Hydraulics, and Pneumatics—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

Acoustics—

Nature of Sound.

Mode and rate of Propagation of Sound.

Musical Tones.

Optics—

Laws of Reflection and Refraction.

Formation of Images by Simple Lenses.

CHEMISTRY.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and Latent Heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

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Combining Proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable Life upon its composition.

Combustion. Structure and Properties of Flame. Nature and composition of ordinary Fuel.

Water. Chemical peculiarities of Natural Waters.

* The knowledge required of these subjects in Natural Philosophy is such as may be attained by attending a course of experiments and lectures.

such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen.

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Heat—

Sources of Heat; conduction—convection.

Effects of Heat; expansion generally—of water—of gases and vapours; liquefaction; vaporisation; latent heat; expansive force of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

Electricity.

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; Conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

Magnetism—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-magnetic and Magneto-electric machines.

Terrestrial Magnetism.

Inorganic Chemistry.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical Combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and properties of Flame. Principles of Illumination. Chemical action of light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast-Iron, Wrought-Iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

For the First Examination, a knowledge of Inorganic Chemistry only is necessary.

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Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners:—

Elementary Substances and their combinations.

Electro-Chemistry.

Radiant Chemical Action.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who most distinguishes himself in Chemistry and Natural Philosophy, will receive an Exhibition of Forty pounds per annum for the next two years.

Second B.Sc. Examination.

Candidates for this Examination who have not previously taken the Degree of B.A. shall be required either to have passed the First B.Sc. Examination at least one Academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate analysis of Organic bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition; determination of the Vapour-density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical history of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyd and Acetic Acid, and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and Oily bodies. Saponification.

Vegetable Acids;—the principal.

Ammonia and its derivatives. Ammonia and Ammoniacal Salts. Amides and Amines; their Classification. The chief natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose. Vegetable Fibrin. Albumin, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumin, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical principles of the process of Nutrition and of Respiration in Plants and Animals.

Examination for Honours.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, most distinguishes himself in Chemistry, will receive Fifty pounds per annum for the next two years, with the title of University Scholar.

Doctor of Science (D.Sc.).

No Candidate is admitted to the Examination for the Degree of D.Sc. until after the expiration of two Academical years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc., in any year, must give notice of their intention to the Registrar, and pay to him a Fee of Ten pounds, on or before the 1st of April.

Chemical Candidates can be examined either in Inorganic or Organic Chemistry; but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge* of the *Principal Subject*, and a general acquaintance with the *Subsidiary Subject*, or *Subjects*, specified as belonging to the Branch so selected.

* It must be understood that the Candidate for the Degree of D.Sc. is expected to be so fully conversant with the Principal Subject he may select, as to be able to go through any examinational test (whether theoretical or practical) of his acquirements in it that can be fairly applied.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or, Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or, Chemical Technology, in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

Examinations in all the before-mentioned Sciences are held annually about May, through the agency of the Local Committee (which must consist of not less than five well-known responsible persons) in any place in the United Kingdom which complies with the requisite conditions. The Examinations are of two kinds, but held on the same evening and conducted by the same committee. *a*. The class examinations for students under instruction in Science Classes, whether taught by teachers qualified to earn payments on results or not. *b*. The honours examinations, of a highly advanced character.

The class examination is of two grades or stages; the first stage or elementary examination, and the second stage or advanced examination.

Application for examination must be made before the end of March, stating the number of persons and the subject or subjects in which they are to be examined.

At the May class examinations the grades of success are:—in the first stage or elementary paper, first, second, and third class; and in the second stage or advanced paper, first and second class. For the third or lowest class the standard of attainment is only such as will justify the Examiner in reporting that the instruction has been sound, and that the students have benefited by it. The standard may be raised from year to year.

To all successful students are given printed lists of results showing their position. To the first class in both stages Queen's Prizes are given, consisting of Books or Instruments chosen by the Candidates from lists furnished for that purpose.

Four medals—one gold, one silver, and two bronze—are given in each subject for competition among the *bona fide* students of Science Classes who either come within the category of persons on account of whom payments can be earned, or who are under seventeen years of age. The Payments on results are made either directly to teachers or to the committee or managers of the school. Persons are qualified to earn payments who have—(*a*) obtained certificates as teachers in any of the before-mentioned sciences according to the rules in force previous to January, 1867; or (*b*) obtained a First or Second Class at the May examination since that date; or (*c*) who have taken honours at the May examination.

No payments are made to a teacher on account of instruction given in subjects in which he is not so qualified.

The student must have received 25 lessons at least from the teacher or teachers in each subject in which payment is claimed since the last examination, each lesson being an attendance at a meeting of the school of at least three-quarters of an hour's duration on a separate day.

There are two Scholarships provided—the Elementary School and the Science and Art Scholarships. In both cases the scholar must be from 12 to 16 years of age and must have passed in a branch of science at the May examination.

Building Grants for New Schools may be made at a rate not exceeding 2s. 6d. per square foot of internal area, up to a maximum of £500 for any one school, under certain conditions.

A grant towards the purchase of apparatus, diagrams, &c., of 50 per cent on the cost of them, is made to Science Schools and Classes in Mechanics' and similar institutions with a properly constituted committee.

Science teachers who have taught two years consecutively, and passed not less than thirty students each year, are allowed second class railway fare and £3 towards their expenses while living in London for the purpose of visiting the South Kensington Museum and other Metropolitan institutions, in order that they may acquire for the benefit of their students a knowledge of the latest progress in those educational subjects which affect the schools, on condition that they remain there five days at least.

CHEMICAL LECTURES.

UNIVERSITY COLLEGE.

WINTER TERM (Oct. 4 to March 31).

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Lectures daily, except Saturday, from 11 to 12 a.m.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £6 6s.; for a Half Course, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—for the Course, £2 2s.; for the Half Course, £1 1s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by Tutors, under the direction of the Professor.

Students cannot profit duly by attendance on the Lectures unless they work at the subject of each Lecture so as to make it their own.

Attendance on the Tutorial part of the Class enables Students to do their work more effectually and rapidly than they can do it by themselves.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The following order of subjects is adopted in it:—

Heat.—Instruments for measuring Temperature. Decompositions produced by Heat. Expansion. Tension of Vapours. Conduction. Convection. Calorimeters. Specific Heat. Latent Heat. Evolution of Heat by Chemical Action, and by Mechanical Action. Mechanical equivalent of Heat.

Light.—Photometry. Refraction and Dispersion of Light. Study of Spectrum. Heat Rays. Chemical Rays. Construction of common Optical Instruments. Double Refraction. Polarisation. Chemical applications of Phenomena of Polarisation. Combinations and Decompositions produced by Light and Actinic Rays. Photography.

Electricity and Magnetism.—Simple Magnetic Instruments. Magnetic and Diamagnetic Bodies. Electrical Machine, Electrophorous, &c. Positive and Negative Electricity. Electrometers. Conduction. Inductions. Leyden-jars, &c. Discovery of Galvanism. Various forms of Battery. Study of the Chemical Action of Galvanic Batteries. Galvanometers. Heating Effects of Battery in relation to Chemical Action. Thermo-Electricity. Rheostat, &c.

Oxygen.—Theory of Combustion. Hydrogen. Nitrogen. Composition and chief changes of the Atmosphere. Carbon, Chlorine, Bromine, Iodine, and Fluorine. Sulphur, &c. Phosphorus. Boron. Silicon.

The chief compounds of these non-metallic elements among themselves are studied in relation to their production, properties, and decompositions. The proportions by weight and by volume in which they combine are explained and illustrated in connection with the atomic theory.

The Second Half of the Course, extending from January to March, includes the following subjects:—

I. Preparation and properties of the chief metals, including their characteristic reactions and most important salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic, Diatomic Metals, &c.

A weekly *vivâ voce* examination is held during the First Half Course and the commencement of the Second Half Course.

II. *Organic Chemistry.*

This commences in the second week in February, and occupies five Lectures weekly till about the end of March. It includes a study of the characteristics metamorphoses of the chief organic acids, bases, alcohols, ethers, colouring-matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of fermentation, &c.

Practical Chemistry.

Mondays, Tuesdays, Thursdays, and Fridays, from 12 to 1.

The course consists of about Forty Lessons, the first twenty being given in the five weeks preceding the Christmas vacation, the remainder immediately after it.

The first half includes the portion of Chemistry required for the Matriculation Examination.

For particulars, see the Prospectus of the Summer Session.

Fee for the course, £4 4s.; Half Course, £2 12s. 6d.

Summer Session (May 2 to July 23).

Practical Chemistry.—Professor Williamson, Ph.D., F.R.S.

I. *Elementary Course.*

About Forty Lessons, of one hour each, on Tuesday, Wedne-day, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee for the Course, £4 4s. including cost of materials and apparatus.

II. *Senior Course.*

About Ten Lessons, of two hours each, on Mondays, from 10 to 12, commencing in the first week in May. The Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerine, &c.; organic bases and alkaloids, constituents of blood, milk, urine, &c.

Volumetric methods of quantitative analysis of acids, alkalies, urea, prussic acid, iron, &c., are practised.

Fee for the Course, £2 2s., including cost of materials and apparatus.

III. *Summer Matriculation Course.*

Professor Williamson, F.R.S., assisted by Mr. F. S. Barff, M.A., F.C.S.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the practical lessons. They include numerous exercises and questions, to which answers in writing are given by the students. These lessons will begin on Wednesday, April 6th, at 11 a.m.

The class will meet on the first five week days, from 11 to 12; and some other Meetings will be announced [illegible] Class has assembled.

[illegible]he Class, £4 4s., including cost of materials [illegible]us.

[illegible]alytical and Practical Chemistry.

Birkbeck Laboratory.

[illegible]uction in the Laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c; study of the qualitative methods of detecting and separating mineral or organic bodies from one another; also quantitative analysis in the wet way, organic analyses, vapour-densities, &c.; instruction in gas-analysis.

More advanced students are instructed in the methods of original research, especially in organic Chemistry.

When accompanied or preceded by attendance on the Lectures on Chemistry, the Laboratory Course qualifies Students in the application of Chemistry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture, &c. Instruction is given in the principles and processes of Gas Analysis.

The Laboratory and Offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners and for advanced Students. They are open daily, from 9 a.m. to 4 p.m., from the 4th of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for Students who can attend only three fixed days per week.

A Gold Medal and Certificates of Honour are competed for by Students entered for the Session.

Evening Classes.

The Session is divided into three Terms, each of ten complete weeks, exclusive of vacations—

I. The Michaelmas Term, beginning on Monday, the 11th of October, and ending on Thursday, December 16th.

II. The Lent Term, beginning on Monday, the 10th of January, and ending on Thursday, March 17th.

III. The Summer Term, beginning on Monday, the 21st of March, and ending on Thursday, June 9th, the Easter Vacation extending from the 14th to the 25th of April, both days inclusive.

The object of these Classes is to extend the benefits of the College Tuition especially to gentlemen engaged elsewhere during the day, and to provide Instruction in subjects not taught in the ordinary College Classes.

The Beadles have orders to admit gentlemen to any of the Classes, with the permission of the Professor or Teacher, as occasional visitors.

The Library is open for the convenience of the Students between 6.30 and 8.30 on the evenings when the Classes meet, except when it is wanted for other purposes.

Elementary Chemistry—Theoretical and Practical.

Professor Williamson, F.R.S., and Mr. Jones. Monday, from 7.30 to 9 30.

A Course of Twenty Lessons, of two hours each, in the Michaelmas and Lent Terms.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject are performed by the Students.

The subject will be the common Non-Metallic Elements and the common Metals, their Compounds and chief Properties, and the best methods of distinguishing and separating them.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

Fee, including the cost of materials, &c., £2 2s. per Term.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

Professor of Chemistry.—Dr. E. Frankland, F.R.S.

The instruction in Chemical Science embraces:—

1. A Course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

2. A systematic Laboratory Course for the Practice of Chemical Analysis.

Chemical Lectures.—The Course consists of Forty Lectures on Mineral Chemistry and Thirty Lectures on Organic Chemistry.

The Lectures are delivered at the Royal College of Chemistry, Oxford Street.

Chemical Laboratory.—The general Laboratory for instruction in chemical manipulation, in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Frankland. The Royal College of Chemistry having become the property of the Government, its Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first week of October, January, and April respectively. The Laboratory hours are from 10 a.m to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory practice.

The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage, when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. The nature of this instruction will be adapted to the special requirements of the Students. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a student who has not furnished satisfactory proof that he is able to obtain accurate results.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is £15 for three months; £12 for two months; and £7 for one month.

Lectures to Working Men.—Short courses of lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within the period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include:—Chemistry, Physics, Applied Mechanics, Metallurgy.

KING'S COLLEGE.

Professor of Chemistry.—W. A. Miller, M.D. V.P.R.S.

Professor of Practical Chemistry.—C. L. Bloxam.

Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal Compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the class, both *viva voce* and by written papers, are held at intervals during the course at the usual lecture hour. Dr. Miller has published a work on Chemistry, which is used as a text-book by the class.

Third Year.—Students who have completed six Terms in this Department are admitted to a Course of "Practical Chemistry," consisting of Twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study, on payment of an extra fee.

Experimental and Analytical Chemistry in the Laboratory.—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of the extra fees, at any time except during the vacation, and for a period of one, three, six or nine months, as may best suit their convenience. The laboratory hours are from ten to four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory fee, each Student defrays the expenses of his own Experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

Analytical and Experimental Chemistry.—Besides the Course of Chemical Lectures and the Summer Class of Practical Chemistry, provision is made for those Students who wish to become more minutely acquainted with the practical details of the science. By means of this Class each Student is enabled to familiarise himself

with the methods of analysis and research. After passing through a preliminary course of analytical operations, each Student devotes himself to such portions of the science as are most interesting to himself, or most likely to be practically useful to him. The Daniell Scholarship of £20, tenable for two years, is given every alternate year for original research in the Laboratory.

The Fees for admission to the Laboratory Class, exclusive of materials, are, for one month, £4 4s.; for three months, £10 10s.; for six months, £18 18s., &c.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter £2 2s. The Classes meet twice a week.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.

17, Bloomsbury Square, W.C.

School of Pharmacy. The session (1869-70) will commence on Friday, October 1st, and extend to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock, commencing on Monday, October 4th.

Part 1.—Physics in relation to Chemistry and Pharmacy.
" 2.—Chemistry of Inorganic Bodies.
" 3.—Chemistry of Organic Bodies.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course, extending over the winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 a.m., commencing on Friday, October 1st. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park, at 8 a.m.

Fees.—For registered apprentices and associates of the Society, for either of the above courses, £1 1s.; for either part separately, 10s. 6d. For those not connected with the Society, £2 2s. for either of the above courses; £1 1s. for either part separately. Students have free admission to the Library and Museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on Friday, the 1st of October, under the direction of Professor Attfield, Ph.D. Fee for the entire session of ten months, Twenty-five Guineas. The Laboratories are open from 9.30 a.m. till 5 p.m. Students can enter at any period during the session.

Two Scholarships (the Jacob Bell Memorial Scholarship) of Thirty Pounds a year each, are open to competition annually in July.

The Board of Examiners meet monthly, and are required by the Pharmacy Act to examine "all candidates who may present themselves for examination in their knowledge of the Latin Language, in Botany, in Materia Medica, in Pharmaceutical and General Chemistry, and to grant Certificates of Competency."

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten experimental lectures; fee, 5s. per term. Subjects:—Junior Class, Chemistry—first year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior class, 7 to 8 p.m., Practical Analysis.

LADIES' MEDICAL COLLEGE, FITZROY SQUARE.

The Course of Lectures on Elementary Chemistry by Mr. John Newlands, F.C.S., will commence on Tuesday, October 5th, at 4 p.m., and be continued on successive Tuesdays at the same hour. Ladies will be admitted to the first lecture on presenting their cards at the College. Further particulars may be obtained on application to the Lady Secretary, at 4, Fitzroy Square.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

EVENING CLASSES.

Chemistry.—Mr. G. Chaloner. Tuesday, 8 to 9.

NEW KENNINGTON INSTITUTE.

Evening Lectures and Practical Classes in Chemistry, under the direction of Dr. Muter.

POLYTECHNIC INSTITUTION.

Course of Thirty Lessons in Inorganic Chemistry, by Mr. G. F. Downar, under the superintendence of Professor Pepper. Tuesday, 8.30 to 10 p.m.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturers.—William Odling, M.B. Lond., F.R.S., Fellow of the Royal College of Physicians, Fullerian Professor of Chemistry at the Royal Institution, and Dr. Matthiessen, F.R.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. Matthiessen, F.R.S. One course, £2 2s.

CHARING CROSS HOSPITAL AND COLLEGE.

INTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. Monday, Wednesday, and Friday, at 10. One session, £5 5s. The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. Monday, Wednesday, and Friday. One session, £2 2s.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Daily, at 10. One course, including the use of apparatus and materials, £4 4s.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Alfred Taylor. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Stevenson. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4s.

LONDON HOSPITAL.

Introductory Lecture on October 1st by C. Meymott Tidy, M.B., C.M., F.C.S., Lecturer on Chemistry at the Medical College.

Lecturers on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B.

The subjects of this course are Physics in their relation to Chemistry and Chemistry Proper. They are alternately made the chief subjects of the course, so that pupils who are studying for the Universities, may, in the period of two Winter Sessions, obtain a full course of Lectures on each subject.

The Lectures are delivered on Monday, Wednesday, and Friday, at 10.30 a.m.

Dr. Tidy has special classes for those reading for the Universities.

Practical Chemistry.—During the Summer Session, Dr. C. Meymott Tidy will deliver a short course of Lectures on Acoustics, in connection with a course on Diseases of the Ear, by Mr. Walter Rivington, M.S., Senior Assistant Surgeon, Lecturer on Anatomy, and Dean.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.C.S. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.C.S. Tuesday and Thursday, at 11.30 a.m.; and Saturday, at 9 a.m. One session, £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturers.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at 11. One session £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, and Friday, at 11. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Tuesday, Thursday, and Saturday, at 11. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 3.30 p.m. One course, £5.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 10 a.m. One course, £2.

PRIVATE TEACHERS OF CHEMISTRY IN LONDON.

Mr. J. C. Braithwaite, 54, Kentish Town Road, N.W.—Chemistry and Toxicology, Monday and Thursday; Latin, Tuesday and Friday; Botany and Materia Medica, Wednesday and Saturday. All the classes commence at 8 p.m. Laboratory open daily, except Saturdays.

Mr. Henry Matthews, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to Medicine, Agriculture, and Commerce. Laboratory open daily, except Saturday, from 10 to 5; on Saturday, from 10 to 1.

Mr. A. Vacher, 20, Great Marlborough Street, Regent Street.

Mr. John Newlands, F.C.S.—Laboratory, 13, Knowle Road, Brixton, S.W. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Dr. John Muter, M.A.—Laboratory, 289, Kennington Road. Instruction in Practical Chemistry and Pharmacy.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Sir B. C. Brodie, Bart., M.A., F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

MICHAELMAS TERM.

Practical Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 1 p.m.

LENT TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

EASTER TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

The Chemical Laboratory of the University is open daily, from 10 a.m. till 6 p.m.; so that Students can work there at such times as may be convenient to them; and the Professor will attend to give instruction at the times above specified.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professor of Chemistry.—Alfred Hill, M.D., Borough Analyst. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. Anderson. Thursday, at 1 p.m.; Friday, at 2 p.m.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Tuesday, Wednesday, and Thursday, at 8.15. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One course, £3 3s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

Professor of Chemistry.—A. H. Church, M.A., Oxon.
Assistant to Chemical Professor.—E. Kinch.

The Collegiate year is divided into Two Sessions. The Autumn Session commences August 9th, divides October 6th, and ends about December 16th. During each Session, the Lectures given and Practical Classes held in the Chemical department are as follows:—

1. *Inorganic Chemistry*—Thirty-six Illustrated Lectures; Ten Catechetical Lectures.
2. *Organic Chemistry.*—Thirty-six Lectures.
3. *Agricultural Chemistry.*—Twenty-eight Lectures.
1. *Chemical Manipulation.*—Twenty-eight Lessons.
2. *Qualitative Analysis.*—Thirty-six Lessons.
3. *Quantitative Analysis.*—A certain number of Lessons.

The Laboratory is also open several hours each day for advanced Students, who occupy themselves, under the direction of the Professor and his Assistant, with the Analysis of Soils, Manures, Feeding Stuffs, Waters, &c.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

WINTER SESSION.

Chemical Lecturer.—Mr. J. C. Brown, B.Sc., F.C.S. Tuesday, Thursday, and Friday, at 10.15. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. J. C. Brown, B.Sc., F.C.S. Monday, Tuesday, and Friday, at 10.15. One course, £3 3s.

The Laboratory is open daily, from 10 to 4.

SCHOOL OF TECHNICAL CHEMISTRY.

7, IRWELL CHAMBERS, OLD HALL STREET, LIVERPOOL.

Conducted by Mr. A. Norman Tate. Assistants—Mr. Walter Tate and Mr. Arnold Millson.

Pupils may attend at any time between the hours of 9.30 a.m. and 5 p.m. (Saturdays, 9.30 a.m. and 1 p.m.), and may work every day, or any number of days, or portion of a day in the week, and for any period most convenient to themselves.

A separate working bench is provided for each Student; and he will also be supplied with all the ordinary chemicals (with the exception of gold, silver, and platinum solutions, alcohol, ether, and similar costly reagents), books for reference, gas, and fuel, and will be allowed the use of balances and weights, and the most substantial portions of laboratory apparatus; but he must provide himself with test tubes, beakers, and other glass vessels and apparatus of a fragile nature required in his researches.

The Course of Instruction, in addition to the ordinary chemical studies, comprises such other subjects as may be required in the prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage; as, for example, in the case of a pupil intended for manufacturing pursuits, he would study architectural and mechanical drawing, so far as is required for the preparation of plans, &c., of chemical apparatus and manufactories, the nature and use of building materials, and the scientific principles and practical rules involved in building and constructive operations, and other scientific and practical information required in the arrangement, construction, and management of chemical manufactories and the application of chemistry to industrial pursuits.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Principal.—Dr. Sheridan Muspratt, F.R.S.E., M.R.I.A., F.C.S., &c.
Assistant.—Mr. Martin Murphy, F.C.S.

The Course of Instruction in this College is entirely devoted to Laboratory work. The term is three months, and dates from time of entrance. Fee for working six days per week, £12 12s.; five days, £11 11s.; four days, £10 10s.; three days, £9 9s.; two days, £8 8s.; and one day per week, £6 6s. Hours of attendance, from 10 a.m. till 5 p.m. The students' laboratories close at 1 p.m. on Saturdays.

Medical students may enter for one hour per day per session. Fee, £3 3s.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. J. Chapman Wilson, F.C.S.

Daily, except Saturday, at 11 a.m. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Mr. Wilson, F.C.S.

Tuesdays and Thursdays, 11 to 12.30. One course, £2 2s.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

SESSION 1869-70.

Chemical Classes for Instruction in Elementary, Practical, and Analytical Chemistry.

Teacher.—Mr. George Ward, F.C.S.

The usual Sessional Course of Instruction in abstract and Applied Chemistry will commence on Thursday, September 23rd, at 8 p.m., on which evening the teacher of the classes will introduce the general subject in a Lecture explanatory of its principles, of the mode in which these should be studied, and also of the plan which he purposes to adopt in conducting the classes during the session.

Fees, payable in advance:—Elementary Chemistry, Thursday, per session, £1 15s.; or 5s. 6d. per month. The subscription includes a selection of apparatus and material specially adapted for the course of instruction. To pupils providing their own materials, £1 1s. per session. Organic Chemistry, Friday, per session, 10s. 6d. Practical Chemistry, Tuesday, per session, £1 1s.; or 3s. 6d. per month, including apparatus and material. The session extends over seven months, from October to April inclusive.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

DEPARTMENT OF MATHEMATICS AND PHYSICAL SCIENCE.

Masters.—T. S. Aldis, M.A. (Cantab.), W. M. Watts, D.Sc. (Lond.); J. Angell, Esq.

There is a large Chemical Laboratory attached to the School, and Chemistry and the various branches of Physics are regularly taught. Arrangements can be made for students to devote their whole time to Physical Science and Mathematics.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. Daniel Stone.

The usual course for the Medical Boards.

A Laboratory is connected with the school.

OWEN'S COLLEGE, MANCHESTER.

(IN CONNECTION WITH THE UNIVERSITY OF LONDON.)

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Junior Class.—Wednesday and Saturday, from 9.15 to 10.15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties and mode of preparation of the non-metallic elementary bodies and their most important compounds.

Senior Class.—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subjects: Inorganic and Organic Chemistry, including the properties of the metals and their compounds, and the composition and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these classes.

Fee, for each class, £3 3s. For both classes, £5 5s.

A Recapitulatory Lecture, without additional Fee, will be given on Friday at 9.15 a.m., which members of both classes will be required to attend.

Extra Class.—Wednesday, from four to five p.m.

Subject: Technological Chemistry.

The Chemical Principles involved in the most important Chemical Manufactures will be chiefly considered in this course. The subject will be discussed as follows, and as far as time will permit.

1. Production of Heat—Heat of Combustion—Combustibles—Coal.
2. Production of Light—Coal Gas—Measurement of Illuminating Power of Coal Gas—Distillation of Coal.
3. Water and Air, as regards their Sanitary and Technological Relations.
4. Processes concerned in the manufacture and application of the Alkalies.
5. Dyeing and Calico Printing.
6. Manufacture of Acids.
7. Manufacture of Glass and Porcelain.

Students attending this Class must be acquainted with the principles of Chemical Science. Fee, £2 2s.

Analytical and Practical Chemistry.

LABORATORY COURSE.

Professor.—Henry E. Roscoe, B.A., Ph.D., F.R.S.

Senior Assistant.—Mr. C. Schorlemmer, F.C.S.

Junior Assistant.—Mr. T. E. Thorpe, Ph.D.

The aim of this course is to make the student practically acquainted with Chemical Science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory Student should attend or should have attended the course of Lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10.30 a.m. until 5 p.m., except Saturdays, when it will be closed at 1.30. The Laboratory is closed from 1.15 until 2, for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research.

Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per

[English Edition, Vol. XX., No. 512, pages 140, 141.]

week, £21; ditto, four days, £17 17s.; ditto, three days, £13 13s.; ditto, two days, £9 9s.; ditto, one day, £5 5s. Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole session.

Special Fees for Shorter Periods.—For six months, six days per week, £17 17s.; five months, ditto, £15 15s.; four months, ditto, £13 13s.; three months, ditto, £10 10s.; two months, ditto, £7 7s.; one month, ditto, £4 4s.

Lectures on the methods of Qualitative and Quantitative Analysis, intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

First year's Laboratory Students are recommended to attend and answer the written exercises and the *viva voce* questions given in this class. Fee, £1 11s. 6d.

Chemical Calculations.—In this class, instruction and special practice is given, by Mr. Schorlemmer, on Wednesday, from 4 to 5 p.m., in the methods of Chemical Calculations, serving as supplementary to the Lecture and Laboratory Courses. Fee, £1 1s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

EVENING CLASSES.

Chemistry.

Professor H. E. Roscoe, B.A., Ph.D., F.R.S.

Lecture Class (First Course—The Non-Metallic Elements).—Monday, from 8.35 to 9.35 p.m.

Lecture Class (Second Course—The Metals).—Mr. T. E. Thorpe, Ph.D. Friday, from 8.35 to 9.35 p.m.

Lecture Class (Third Course—Organic Chemistry).—Mr. C. Schorlemmer, F.C.S. Friday, from 7.30 to 8.30 p.m.

Laboratory Courses of Practical Chemistry.

Professor Roscoe, F.R.S., and Mr. Schorlemmer, F.C.S.

Junior and Senior Divisions.—Monday, from 6 to 8.30 p.m.

Pharmaceutical Course.—Monday, from 6 to 8.30 p.m.

COLLEGE OF MEDICINE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.)

Education in Pharmacy.—The Council of the College have added a Lectureship on Pharmacy to those at present existing. The proposed curriculum for Students in Pharmacy will consist of attendance on Lectures on Botany, Materia Medica, Chemistry, and Pharmacy. The Lectures on the two former of these subjects will be delivered in the summer, and those on the two latter in the winter session of study.

Lecturer on Chemistry.—Mr. A. Freire-Marreco. Monday, Wednesday, Thursday, and Friday, at 4 p.m.

EVENING COURSES.

Chemical Physics.—Every Monday, at 7.30 p.m.

Inorganic Chemistry.—Every Wednesday, at 7.30 p.m.

Practical Pharmacy.—B. S. Proctor. Every Tuesday, at 7.30 p.m.

This course will include—General Processes and Physics applied to Pharmacy—Pharmacopœial Processes, and the most important recent improvements in Pharmaceutical preparations—Dispensing operations—Testing and the Test Solutions of the Pharmacopœia. The course will be illustrated, whenever practicable, with apparatus, experiments, and processes in operation.

Practice of Chemistry.—The Laboratories are open daily throughout the year from 10 to 5 o'clock. Non-Medical students can attend Laboratory practice and receive Instruction in Analysis.

Students attending the Laboratory practice and Lectures on Chemistry, who have passed the Durham Registration Examination, or any Examination in Arts recognised as its equivalent, will be registered on the books of the College as Matriculated Students in Chemistry.

Fees.—Perpetual ticket for Pharmacy Course, £6 6s. (this applies only to Students at present engaged in Pharmacy, and who enter before October, 1871). Separate Courses of Lectures (each), £4 4s. Laboratory Practice, 6 days per week—Three months' ticket, £9 9s.; six months' ticket, £16 16s.; twelve months' ticket, £31 10s. Special arrangements for shorter attendances. These fees admit to all the courses in Chemistry. For a certificate in Chemistry, 10s.

SHEFFIELD.

Mr. W. Baker, F.C.S. Laboratory for Theoretical and Practical Chemistry, 46, High Street, Sheffield.

SCHOOL OF CHEMISTRY.

1, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry, in connection with the Science and Art Department.

Day and Evening Classes for Analytical Chemistry.

SHEFFIELD SCHOOL OF MEDICINE.

During the Winter Session, Mr. A. H. Allen, F.C.S., will deliver a Course of Forty-five Lectures on Chemistry.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.

ROYAL COLLEGE OF PHYSICIANS AND SURGEONS, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh, and other Universities; the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

The Lectures on Chemistry commence on Wednesday, November 3rd, and continue to be delivered daily during the five months of the Winter Session. The Lectures form a complete Course; the New Nomenclature and Notation are employed throughout, and spe

in Technological Chemistry are given.
ss Examinations are held during the Ses-
Excursions are arranged for visiting the
hemical Manufactories.
uctions in Analytical Chemistry are conducted
boratories at Surgeons' Hall, which are now
y, under the personal superintendence of Dr.
, for the instruction of gentlemen in Chemical
, and the prosecution of researches in Manipu-
hemistry.
Prelections in Practical Chemistry are also con-
in the Laboratories at Surgeons' Hall. The
ts selected for Examination are those with which
cal Students are specially called upon to exhibit a
tical acquaintance.
es.—Lectures, £3 5s. (University Graduation, £4
Practical Chemistry (University, &c.), £3 3s.;
ytical Chemistry, £2 per month, £5 for three
ths, or £10 for six months.

NDERSONIAN UNIVERSITY, GLASGOW.

rofessor of Chemistry.—Dr. Penny, F.R.S.E., F.C.S.,

Systematic Course of Lectures and Demonstrations
hemistry, for Medical Students, Manufacturers,
Engineers, Agriculturists, &c. Daily, except
day, from 12 to 1, commencing 27th of October
rminating in April, £2 2s.
bject of this Course, which comprises upwards
ectures, is to convey to the student a thorough
ge of the principles of Chemistry, and the
ions of the science to Medicine, Manufactures,
ture, &c.
icates of attendance on these Lectures are
by the Royal College of Physicians of London
inburgh; by the Royal Colleges of Surgeons of
, Ireland, and Edinburgh; by the Faculty of
ns and Surgeons of Glasgow: by the Army,
nd East India Boards; and by the Apothecaries'
They also qualify for Graduation in the Univer-
ondon, &c.
ruction in the various branches of Practical
y, and Analysis in the Laboratory. Daily,
to 4.
the usual preparatory training, the attention of
udent is specially directed to the examination
nalysis of Minerals, Products of Commerce and
facture, Manures, &c., and, when desired, to
al Research.
The Private Laboratory for Commercial and
analyses and assays, and for consultations and
investigations. Open daily, from 10 to 5,
hout the year.
vening Course of Popular Lectures on the Gene-
nciples of Chemistry, and its application to the
s branches of the Useful Arts. On Fridays, at

dents attending this Course have the privilege of
eting for the Prizes and Certificates offered by the
ty of Arts, and the Government Department of
ce and Art.
Evening Course of Instruction in Practical Chemis-
nd Analysis. On Thursday, from 7 to 9.
Summer Course of Practical Chemistry for Medical
nts. Three months, commencing in May, £2 2s.
ung's Chair of Technical Chemistry.—This new
, which has been founded by Mr. James Young
onnection with the Andersonian University, has been accepted by Mr. W. H. Perkin, F.R.S. We hear that the Laboratory will be opened in January next, and will accommodate about forty students.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

GLASGOW MECHANICS' INSTITUTION.

Lecturer on Chemistry.—Dr. R. Carter Moffat.

1. Course of six months morning Lectures, qualifying for the various Medical Examinations, and also suited to the requirements of Manufacturers, Civil Engineers, &c. Daily, at 10. Begin 25th October.

2. Day and Evening Experimental Classes are held in the Laboratory, by Dr. R. Carter Moffat. Hours, from 10 till 4, and 7 till 9.

In these Classes, Students are instructed individually, and not as members of a class, so that every facility is given for the thorough attainment of the various principles and methods in Analysis, &c. Students may enter at any time; and the Classes are suitable for beginners as well as for advanced pupils. All are supplied with Apparatus, &c., and they personally perform their own Experiments. Those desiring it may take up, on entering, any department they choose—as, for example, the Analysis of Substances for Trade purposes, or investigations relative to the Improvement of certain Manufacturing Processes, and the Discovery of New Materials useful in the Arts, &c.

3. Popular Evening Lectures, every Monday, at 8.30, for six months.

4. Medical Students' Practical Class in Summer, commencing May 3rd. £2 2s.

GLASGOW VETERINARY COLLEGE.

Professor of Chemistry and Materia Medica.—Dr. R. Carter Moffat.

The Session will commence on Monday, October 25th, 1869.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. Apjohn, F.C.S.

The Lectures will commence on Wednesday, November 2nd, at 2 o'clock, and be continued each Tuesday, Thursday, and Saturday.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

The Professor receives operating pupils into the Chemical Laboratory.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews.

QUEEN'S COLLEGE, CORK.

Professor of Chemistry.—Dr. Blyth.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medica[illegible]he summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND,

Stephen's Green, Dublin.

This College supplies, as far as practicable, a complete course of Instruction in Science, applicable to the Industrial Arts. The Subjects of Instruction are:—Pure and Applied Mathematics, Descriptive Geometry and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology and Paleontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical Chemistry.—W. K. Sullivan, Ph.D., V.P.R.I.

Professor of Analytical and Applied Chemistry.—R. Galloway, F.C.S.

Assistant Chemist.—Wm. Plunkett, F.C.S.

A Course of Lectures on Inorganic and Organic Chemistry is delivered by Dr. Sullivan three times a week during the Session. Fee for the entire course, £2.

A Course of Lectures on Technological Chemistry is delivered by Mr. Galloway twice a week during the session. Fee for the course, £2.

The Chemical and Metallurgical Laboratories, under the Direction of Mr. Galloway, are open every week day during the session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical research. Each student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the session of nine months, £12; or for three months, £5; or for one month, £2.

Students have access to the extensive Library of scientific books in the College, and have the privilege of borrowing the books.

There are four Royal Scholarships, of the value of £50 each, yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year. These are awarded at the annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three years' Course.

The Session commences on Monday, October 4th.

NOTICES OF BOOKS.

Abridgments of Specifications Relating to Acids, Alkalies, Oxides, and Salts. A.D. 1622—1866. Printed by order of the Commissioners of Patents. London, 1869.

We have here before us, condensed into a neat volume containing about 1100 small octavo pages, a most useful as well as a most valuable record of the history and course of inventions on the domain of practical and technical chemistry for a period of nearly two and a half centuries. The number of specifications, from the earliest period to the end of the year 1866, amounts to no less than 59,222.

This work, besides embracing all inventions relating to the making or obtaining by any direct or indirect methods of acids, alkalies, oxides, or salts, includes inventions relating to the making or obtaining of several elementary bodies; among which are bromine, iodine, chlorine, fluorine, carbon, hydrogen, nitrogen, oxygen, and sulphur, and some compounds—as, for instance, cyanogen.

There is in this excellent work such an *embarras de richesse* as regards the subjects for quotation that it is very difficult to make a choice out of such an abundance of matter. For curiosity's sake, we quote, from the first page, the following:—

A.D. 1623, February 23, No. 23.—Jones, Roger, and Palmer, Andrewe, "Makeing of hard soape with a material called berilia, and without the vse of any fire in the boyling and makeing thereof; and also of makeing of soft soape without the use of fire in the boyling thereof." The "berilia" consists of ashes of "beanestrawe," "peasestrawe," and of English kelpe. *Queritur*—What is, in this phrase, the meaning of the words "without fire?" Does it refer to saponification in the cold? or was steam already used by some for boiling other liquids? Since no specification is enrolled, this question remains unanswered.

This work, to which are added copious indices of subject matter, and of names, will be highly welcomed, both by manufacturers and parties directly interested in patents, and specifications thereof; the work is a valuable addition, also, to the scientific bookshelves and libraries of the day; and the whole manner of execution and abridging of abtruse matters, too often very imperfectly worded, reflects great credit upon the gentlemen to whom the excellent head of the Patent Office has entrusted a task which deserves the praise of all who can understand the difficulty of the proper execution of that task.

Notwithstanding that the book contains nearly 1100 closely-printed pages, it is sold at a very reasonable price, while the paper and typographical execution are also commendable.

Alkali Act, 1863; *Fifth Annual Report by the Inspector of His Proceedings during the year* 1868. Presented to both Houses of Parliament. 1869. Eyre and Spottiswoode.

It will be in the memory of all of us that, in 1863, Lord Derby brought in a bill for the removal of the nuisance caused by alkali works. It had long been noticed that, in the neighbourhood of such works, no kind of vegetation could flourish; and other evils were found to result. It was hence proposed that means should be adopted for preventing the escape of hydrochloric acid into the air, and that an Inspector should be appointed to see that the enactments of the bill were properly carried out. Inasmuch as the bill was entirely free from any party influence, it rapidly received the assent of both sides of both Houses, and became law somewhat more than five years ago. Dr. Angus Smith was appointed Inspector, and he has annually issued a report, that which we are about to notice being the fifth.

In the report for 1867, the escape from the hydrochloric acid condensers was stated to be under 1 per cent, while 2 per cent was allowed for leakages through the brickwork. No diminution of this amount can be shown for the succeeding year, although, in the case of "open-furnace works," the escape is much smaller, and is considered to be not more than 0·5 per cent, leakage included. Various new furnaces have, however, been constructed, and it is confidently expected that the escape may ultimately be reduced to almost a vanishing quantity.

From page 6 to page 22, the space is occupied by accounts of various alkali works, and the improvements effected during the year; and first in the case of works with open roasters:—

No. 53. To each condenser is connected a wash-tower containing 400 cubic feet of condensing space. The escaping gases were found to be reduced in temperature 400° F. between the roaster and condensers; the acid obtained was of 19° Twaddle, and the escape was 0·9 per cent.

No. 115. These are new works, and consist of one decomposing pan, a pan condenser 60 feet high, containing 2,400

cubic feet of condensing space, and one roaster condenser with two shafts, each containing 1400 cubic feet. Charge, 6 cwts. per hour; escape, 1·9 per cent.

No. 68. The escape varied from 1 to 5 per cent.

Secondly, in the case of works with close roasters:—

No. 45 March 3.—Two spots with flanges and rims, and close furnaces are used. A large quantity of acid found in the flue. April 7.—A large quantity of acid found in flue. July 16.—A new furnace, constructed with great care, was set to work; but the results were unsatisfactory, and the escape large. Ultimately, after many trials, another new furnace was set to work, on November 12th, and the result was found to be satisfactory, and the escape of acid small. However this may be, the above results sufficiently indicate the advantage of the "open-furnace" system, unless there are certain drawbacks connected with it in reference to other matters than the provisions of the Alkali Act. The testing-glasses of Mr. Kane continue to work well, and to indicate with precision an undue escape of acid into the flues. The main difficulty appears to be to prevent leakage through the hot brickwork of the furnaces, since the amount of acid escaping with the smoke can be reduced by condensation to certainly 0·5 per cent, and, by lessening the velocity of the escaping current, to even less than this.

In regard to the matter of cooling flues, experiments have been made as to the relative cooling powers of brick and iron flues, with the following results:—

An underground brick flue cooled 7° F. per 10 feet.
An overhead brick flue cooled 18° per 10 feet.
An overhead cast-iron flue cooled 30° per 10 feet.

Thus the iron flues are most advantageous as regards cooling effect, but they are somewhat rapidly acted upon by the evolved gases, and do not last so long as brick flues. The following analyses show the composition of the deposits from cast flues in Mr. Mease's works. The "up pipe" was 65 feet from the furnace, and the temperature 468° F. The "down pipe" was 130 feet from the furnace, and the temperature 289° F.

Analysis of the Deposit in Cast-Iron Flues.

	Up pipe.	Down pipe.
Peroxide of iron	19·866	26·946
Alumina	3·171	4·614
Lime	0·371	0·486
Magnesia	0·414	0 298
Soda	11·311	2·808
Sulphuric acid	53·212	48·077
Chlorine	2·141	2·034
Water, loss, &c., in addition.		

A number of estimations of the sulphur in coal have been made by Dr. Angus Smith and Mr. Fletcher. An examination of 70 specimens of South Lancashire coal by the former showed an average percentage of 1·1 of sulphur; while the examination of some specimens of St. Helen's coal by Mr. Fletcher showed a minimum of 0·6, and a maximum of 2·22, per cent of sulphur. If 300 cubic feet of air are used to burn 1 lb. of coal containing 2 per cent of sulphur, the amount of sulphurous acid in the smoke will be a little more than 1 grm. in a cubic metre, since that is equal to 35·318 cubic feet.

A number of very interesting analyses are given of the composition of coal-smoke (pp. 26 to 34), from which we extract the following:—

Chimney of a sugar refinery, 200 feet high. Smoke taken from a height of 30 feet from the ground. Speed of smoke, 12 feet per second. Internal diameter of the chimney at 30 feet from the ground, 10 feet. Amount of coal burnt per day, 35 tons.

	Black smoke.	Common brown smoke.
CO_2	6·64	4·26
CO	0·40	—
O	11·17	16·63
H	—	—
CH_4	0·02	—
C_nH_{2n}	—	—
N	81·77	79·11
	100·00	100·00

One hundred cubic feet of black smoke were found to contain, in addition to the above gases, 1047·44 grains of water, and 18·52 grains of soot.

It was considered very advisable that the condition of the air at some distance from alkali works should be known; and this, as regards its acidity, would be obviously best determined by examining the rain-water collected direct in porcelain vessels.

The maximum acidity (*calculated as sulphuric acid*) of rain which fell in Manchester in 1857 was 7·3960 grains per gallon, and the minimum 0 3169 grains per gallon.

Pendleton, Manchester. 1857.

Maximum acidity, 3·3810 grains per gallon.
Minimum " 0·2641 " "

Hulme, Manchester. 1857.

Maximum acidity, 2·5886 grains per gallon.
Minimum " 1·3734 " "

Rain; Manchester. 1868.

Maximum HCl, 1·2775 grains per gallon.
Minimum " 0·0278 " "
Maximum $HOSO_3$, 5·6000 " "
Minimum " 1·4000 " "

The total acid in rain collected from various sources bears the following relationship:—

Row, Dumbartonshire	100·00	= 1
Whiston, ten miles from Liverpool	470·67	= 4¾
Birkenhead	528·29	= 5¼
Liverpool	938·21	= 9⅜
Waterloo, on the shore	961·98	= 9½
Newcastle-on-Tyne	1054·73	= 10½
Manchester	1175·54	= 11¾
Near an alkali work	1539·27	= 15⅜

We can scarcely be surprised, after glancing at this table, at the rapid decay of stone in certain localities, compared with others, and the long endurance of buildings of antiquity which are far from large towns, and in a pure and open air—such as the Parthenon, and the Pyramids of Egypt.

Some very interesting drawings are given by Dr. Angus Smith, on page 46, of the microscopic appearance of rain-water residues; and we are told that oxide of iron, sulphate of soda, phosphates, chloride of ammonium, and other substances may be readily detected in the rain of some localities. We are surprised to find that Dr. Smith has not examined any of the residues spectroscopically, as this would appear to offer the best means of detecting the minute traces of substances which are present; or is it that, in point of fact, almost every element would be detected by such an infinitely delicate test? Certainly, Bunsen has found that lithia is generally present in the air near the sea shore. Accordingly to M. Robinet (*Comptes Rendus*, 1863, p. 493), the Paris rain-water contains a substance which gives a garnet-red precipitate with nitrate of silver. In a summary of results obtained, Dr. Smith gives, among others, the following conclusions:—

"The rain from the sea (Western Islands) contains chiefly common salt, which crystallises clearly.

"The sulphates increase inland before large towns are reached.

"The sulphates rise very high in large towns, because of

the amount of sulphur in the coal used, as well as decomposition.

"When the air has so much acid that two or three grains are found in a gallon of the rain-water, or forty parts in a million, there is no hope for vegetation in a climate such as we have in the northern parts of the country.

"Free acids are not found with certainty where combustion or manufactures are not the cause.

"Experiments in the direction indicated above may enable us to study and express in distinct language the character of a climate, and certainly of the influences of cities on the atmosphere."

In the Appendix to the Report will be found an interesting letter by Mr. A. E. Fletcher, "On the Speed of Air in Flues," as determined by the ether anemometer invented by himself, and described some time ago in this journal (vol. xvi., p. 141). The tables will be found of especial value: the one giving the corrections for temperature in a range of from 0° to 1000° F.; the other to show the conversion of the anemometer indications into the speed of the air current, with a range from 0·903 to 40·37 feet per second.

The report, as a whole, contains much valuable information, and is an important contribution to our knowledge of technology. Its range extends far beyond the more immediate subject of inquiry. The composition of the air of towns, as indicated by the solid residue of the rain, affects all of us, not alone as regards our health, but further, in relation to the preservation of our national monuments and public buildings. The comparison of the death-rate of various towns indicates the influence of impure airs upon the duration of our lives. Dr. Angus Smith has done much towards the examination of the influences of impure air and water upon mankind, and we hope he will continue his labours in the same fertile field.

Arithmetical Exercises for Chemical Students. By C. J. WOODWARD, B.Sc., Lecturer on Chemistry and Physics, Midland Institute, Birmingham. Birmingham: The Educational Trading Company (Limited). London: Simpkin, Marshall, and Co.

WE have received, under the above title, a series of ten very neatly printed cards, enclosed in a case. Instead of "Exercises for Chemical Students," it would have been better to write Students of Chemistry.

The author very properly and truly states that, in almost all examination papers on the subject of chemistry, there are introduced questions involving considerable arithmetical calculation. Each card of this series contains all the data necessary for working the problems, and certain questions, which may be looked upon as *type* questions, are worked out in full. The subjects include—(1) the metric system of weights and measures; (2) the conversion of thermometer scales—correction of gases for pressure and temperature; (3) specific gravity; (4) formula of a body being given, required either its percentage composition, or the quantity of any constituent a given weight of it will contain; (5) percentage composition of a compound being given, required its empirical formula; (6) quantity of material to yield, liberate, or produce a given weight of a substance; (7) required the bulk of a substance produced in certain decompositions, or, conversely, the volume of a substance necessary to effect certain decompositions; (8) combinations and decompositions of bodies in the gaseous form; (9) the crith and its uses; thermal units (by "crith" is understood the weight of 1 litre of hydrogen at 0° C., and 760 m m. Barometer); (10) specific, atomic, and latent heat.

Very opportunely, these cards have been published at the moment that the courses of lectures are commenced at the various schools in the kingdom. A careful perusal justifies us, we think, in recommending these cards to all students of chemistry and physics; and a number of teachers will also find them a very useful addition to their library-table. As far as perusal goes, we have no fault to find with this work; and its very moderate price, especially considering the large amount of highly useful information contained in ten duodecimo cards, holds out a good inducement for students who really desire to obtain, within a very small compass, a permanently-useful pocket companion to purchase this work.

CORRESPONDENCE.

Impurity of Indigo.

To the Editor of the CHEMICAL NEWS.

SIR,—Having been in the habit of experimenting on indigo, in order to arrive at a relative value of different samples, in order to rate the proper quantities for dyeing stated quantities of fabric, I was not under the necessity of examining the article for anything but its active colouring principles. But, a short time since, in making sulphate of indigo, I poured the solution from the dregs, and, throwing the sediment away, I kept the solution in a glass-stoppered bottle, exposed to strong light, and, at the end of a couple of months (not being at leisure to attend to this lot sooner), I found, on examination, that the contents of the bottle were almost solid, only about one-fifth of the whole being liquid.

I filtered the fluid portion from the solid, and obtained only a very small quantity of indigo carmine as result of examination, the solid mass being composed of a dirty blue powder, which I washed away, being anxious to get at the principal matter in the mixture. After washing thoroughly, I obtained a heavy lot of fine, white needles, which had formed during the time that the solution was standing. Some blue spots adhering, I washed with dilute nitric acid, and then with water, obtaining the crystals tolerably clean.

I have consulted Watts's "Dictionary," and other works at my command, and, of all the reactions mentioned in connection with any of the salts of indigo, not one of them makes an impression on the mass.

Tested with SO_3, NO_5, HCl, and with aqua ammonia, sulphuric ether, alcohol, hot and cold water, also a solution of caustic potassa, none of which have any effect, as a drop on glass dries off without leaving a crystalline residue to show solution having taken place.

Heated to a cherry-red heat, the silky needles lose their pearly brilliancy, but still obstinately refuse to answer any of the reagents applied to them.

I have not applied hydrofluoric acid for fear of using all my stock of crystals up without arriving at a satisfactory solution, and have none left to send you.

I transmit herewith the balance of the crystals left in good order for your inspection, hoping you can throw some light on the compound.

The indigo from which these were obtained is an article known in the American market as "Madras" indigo, and, as this must indicate very extensive adulteration, I have ventured to trouble your patience with a history of it, in the hope that it may be of interest. If the subject is worth further efforts, I am ready to follow any suggestions as to the mode of procedure you may see fit to offer.

In conclusion, I will state that the SO_3 used to form the sulphate was bought as being chemically pure, but I did not test it; although, if it had been sophisticated with sulphate of soda, the result would not have been an insoluble compound, and, as the indigo was pounded fine in a mortar, and passed through a very fine sieve, the crystals could not have been in their present shape previous to the examination of the specimen.—I am, &c.,

NEW BERNE.

New Berne, N.C., U.S.A., July 27th, 1869.

[The substance of which our correspondent sent a sample proves to be soluble in boiling dilute hydrochloric acid. This solution yields a dense precipitate with chloride of barium, a flocculent precipitate with ammonia (alumina), and a strong precipitate with oxalate of ammonia. It is evi-

dently a mixture of sulphate of alumina and sulphate of lime: other tests which have been applied confirm this statement. If the indigo had been ignited, our correspondent would have been able to judge of its quality from the quantity of ash. Good indigo leaves from 4·5 to 5·0 per cent. of ash; but the less the better, of course. A mixture of pipe-clay and milk of lime is frequently used in the preparation of indigo; hence the phenomenon which puzzled "New Berne."—*Ed.* C.N.]

Improved Bunsen's Filter.

To the Editor of the Chemical News.

Sir,—Bunsen's filter being now in such general use, and such a necessary adjunct to a good laboratory, it seemed to me that any small improvements in connection with it could not fail to interest your readers.

In the place of the cone of platinum foil recommended by Bunsen, I now use a cone made either of platinum or copper gauze. When the fluid which passes through the filter does not act on copper, I prefer the latter. The cones are cut just as Bunsen describes, but can be fitted to the funnel direct, that is without the use of a matrix of plaster-of-Paris. This is accomplished by pressing the cone into the funnel to be used, with a piece of wood turned as nearly as possible to the proper angle. I may add that during the last three months, in which these cones have been in almost daily use, I find them to filter much quicker than the foil cones, and with quite as little risk of breaking the paper.—I am, &c.,

R. S. Dale, B.A.

Cornbrook Chemical Works, Hulme, Manchester, September 8th, 1869.

MISCELLANEOUS.

Explosion caused by Ammonia Gas.—M. Werner.—On the 18th of February last, an explosion took place at the chemical works of Messrs. Kunheim & Co., Berlin. It appears that a large iron vessel of cylindrical shape, 6 feet in diameter, and 4½ feet high, and 13-16ths of an inch in thickness, was used for the evolution of ammonia gas from a somewhat thickish magma; but this operation had been carried on in the same manner for twenty years, and with iron vessels of similar description, which were properly renewed when required. It was this apparatus which exploded; and the author states that the vessel was strong enough to withstand a pressure of 20,000 pounds to the square inch. The apparatus have since been provided with safety-valves; for it appears that the explosion took place immediately after the apparatus had been filled with about 4000 lbs. of ammoniacal liquor, and that the explosion was the joint effect of steam and ammonia gas. The iron apparatus was found to be throughout well made, of good quality and strength, and only a suddenly-applied force would break it.—*Zeitschrift des Vereines Deutscher Ingenieur.*

Testing Acetic Acid.—The value of commercial acetic acid can be estimated by ascertaining how much soda, or carbonate of soda, a given weight can neutralise. Inorganic acids, if present, would also neutralise the alkali; they must be tested for separately, or the determination corroborated, by evaporating the neutralised liquor to dryness, and calcining it at a red heat. All the acetate of soda is then converted into carbonate, the quantity of which may be dosed by the test acid; if it corresponds in quantity with the alkali first required to neutralise the acid, there is no mineral acid present; if it falls short the difference may be ascribed to some mineral acid, the soda-salt of which is not decomposed by red heat. Good commercial acetic acid contains from 18 to 22 per cent of anhydrous acetic acid, and traces only of sulphates and chlorides. When 100 grains of acetic acid neutralise 62 grains of crystallised soda, the acid contains 23 per cent of anhydrous acetic acid. Acetic acid should be tested for lead and copper, for sulphuric, hydrochloric, and nitric acids, should be entirely volatile on being boiled, and, when concentrated, its vapour should readily ignite on being approached by any flame. The strength of vinegar can also only be determined by the same means as indicated for acetic acid. When acetic acid or vinegar are evaporated to dryness on a water-bath, after addition thereto of a few drops of a strong clear solution of loaf-sugar, there should not ensue a deep brownish or black coloration on the residue becoming dry, which would indicate the presence of sulphuric or hydrochloric acids. Vinegar always contains sulphates and chlorides, and, if deeply coloured, also organic matter; the presence of the salts just named is due to the water applied in making the vinegar. Acetic acid should be free from tarry matters and aceton; they will be discovered on gently evaporating, and also on saturation, best with pure carbonate of lime.

Professor Church, M.A.—The *Lancet* of August 28th in noticing a report read at the Exeter meeting of the British Association, "On the Spectroscopic Examination of Animal Substances," refers to Professor Church's investigation of the red colouring matter of the wings of the turaco, and believes that Professor Church is the Assistant Physician to St. Bartholomew's Hospital. We have been requested to state that the investigator is not Dr. W. Church of St. Bartholomew's Hospital, but A. H. Church, M.A, Professor of Chemistry at the Royal Agricultural College, Cirencester.

New Chemistry Chair at Anderson's University.—A special meeting of the trustees of Anderson's University was held on Wednesday last for the purpose of considering the proposal of Mr. James Young, of Kelly, to found a chair of technical chemistry in connection with the University. Mr Harvie was called to the chair. A letter was read from Mr. Young, intimating his intention to invest £10,500, in six trustees and himself, for the purpose of establishing a chair of technical chemistry, and requesting the managers and trustees to lease to him the building adjoining the University recently presented by Mr. William Euing, to be altered and fitted up by the trustees. The managers had given their assent, and they now asked the concurrence of the trustees. The Secretary read the deed of trust by Mr. Young in favour of his trustees, directing how the 10,000 guineas were to be appropriated in providing for the lecturer, providing apparatus, altering the building, &c. The trustees were empowered to establish bursaries, scholarships, &c. His six trustees must be trustees of Anderson's University. It was intimated that Mr. Young, with the consent of his fellow trustees, appointed Mr. W. H. Perkin, F.R.S., to the lectureship. This gentleman, like Mr. Young himself, is the founder of an important chemical industry, he being the first discoverer in the department of the aniline or coal-tar dyes. The offer was accepted, with one dissentient.—*Scientific Opinion.*

Spiders' Silk.—A bar of iron 1 inch in diameter was sustain a weight of 28 tons; a bar of steel 50 tons; and, according to computation, based upon the fact that a fibre only 1-4000th of an inch in diameter will sustain 54 grains, a bar of spiders' silk 1 inch in diameter would support a weight of 74 tons.

Contribution to the History of Pyrrol.—No Lubavin.—It is pretty well known that this substance is the product of the destructive distillation of bones, pit-coal, and other nitrogenous substances. Pyrrol has been only slightly submitted to research. It is known to have the formula C_4H_5N. It does not form salts; is not decomposed by fusing with caustic potassa. Treated with acids, it yields pyrrol-red; while it has the property of colouring a piece of fir-wood, previously moistened with hydrochloric acid, red. About two years ago, M. Goldschmidt discovered that, when pyrrol is oxidised with moist oxide of silver, it is converted into a crystalline substance endowed with the properties of an acid. However, only a very small quantity of this substance was obtained by him. M. Lubavin, although operating upon

large quantities of pyrrol, succeeded no better than M. Goldschmidt, when repeating his researches on pyrrol and its oxidation by means of oxide of silver; while the very small quantity of the crystalline substance obtained by him by this reaction proved to be as ready a reducing-agent for the said oxide as the pyrrol itself. Pyrrol appears to be extremely indifferent to any reagents at all, or, if acted upon, is readily converted into pyrrol-red. Sodium does not affect pyrrol at the ordinary temperature of the air: when heat is applied, some gas is disengaged. Potassium, however, acts strongly upon pyrrol; a large quantity of gas is disengaged; heat is developed; and on cooling, the entire mass solidifies, forming a crystalline compound; this appears to be pyrrol-potassium, since, on treating it with water, pyrrol is obtained unchanged while, on treating it with iodide of ethyl, ethyl-pyrrol is produced. The potassium combination has the formula C_4H_4KN. When large quantities of pyrrol are operated upon, some resinous substance is also produced. Ethyl-pyrrol is a colourless liquid, which, however, soon becomes first yellow, next red. Its smell is akin to that of oil of turpentine. It is hardly at all soluble in water, and specifically lighter than that fluid. Ethyl-pyrrol becomes resinous when exposed to air; is soluble in hydrochloric acid, thereby becoming deep-red coloured, and emitting dense white fumes. On boiling this solution, no solid substance is deposited, but, on addition of an aqueous solution of caustic potassa, an amorphous, solid substance is precipitated. The vapours of ethyl-pyrrol have the same characteristic property as pyrrol, viz., to render red-coloured a piece of fir-wood previously moistened with hydrochloric acid. The percentical composition of ethyl-pyrrol for the formula $C_4H_4(C_2H_5)N$ = Carbon, 75·8; hydrogen, 9·5; nitrogen, 14·7. The boiling point is between 160° and 175° C.—*Berichte d. Chem. Gesel. z. Berlin.*

Non-Poisonous Colours.—We have received two samples from Mr. F. Pettit, viz., yellow zinc and green zinc; and, after having tested them, we are satisfied that the statements made by the makers of these colours are correct. Of the beautiful yellow and green pigments we have had the opportunity of testing, we affirm with pleasure that (1) they are not poisonous: (2) they do not become discoloured by the effects of burning gas; (3) they are not affected by sulphuretted hydrogen gas, and are not altered in shade—as far especially as the green is concerned—by artificial light. For paper-stainers, the manufacture of surface-coloured paper, for mixing with plaster-of-Paris for ornamental stucco work on walls, these colours will answer well, as they also will for mixing oil pigments, while, for pigment cotton printing, chromo-typography, and lithography, they will supply colours of great brilliancy, durability, and quite sufficient body.

London Gas.—It is stated that one hour after the gas of London is lighted the air is deoxidised as much as if 500,000 people had been added to its population. It is also stated that, by the burning of gas twenty-four hours in London, more water is produced than would supply a ship laden with emigrants on a voyage from England to Australia.

Artificial Light.—The German chemist Landsberg says that artificial light contains 90 per cent of calorific rays, while sunlight contains only 50. To the number of these rays he attributes the disagreeable sensation produced upon the eyes by artificial light. By passing it through alum or mica, the calorific rays are interrupted, and the light rendered more agreeable and less injurious.

The Humboldt Centenary.—On the 14th of September, 1769, was born Alexander von Humboldt. According to the *Moniteur Belge* of this date, 1869, there is a plan on foot at Berlin to found and establish a Humboldt Palace, wherein would be united together the libraries of all the literary and scientific societies existing at Berlin, all of which would have their meeting rooms in that palace also.

Death of the Master of the Mint.—With sincere regret, we learn that Professor Thomas Graham, F.R.S., Master of the Mint, died on Thursday night, the 16th Sept., at his residence in Gordon Square. Mr. Graham succeeded Sir John Herschel at the Mint in April, 1855, and was, at the time of his decease, in his sixty-fourth year. He was born at Glasgow, on the 20th of December, 1805. He was the son of a Glasgow merchant, and was educated at the Grammar School and the University of that city, and afterwards spent some years in Edinburgh. He returned to Glasgow, where he distinguished himself as a practical chemist, and was elected Professor in the Andersonian Institution. In 1837, he was appointed Professor of Chemistry in University College, London, and, in 1855, he was appointed Master of the Mint. To the duties of this office he applied all his varied scientific knowledge, and, at the same time, devoted himself to original investigations in his favourite science. To him we are indebted for the discovery of the laws of the diffusion of gases, the diffusion of liquids, and the new method of separation known as dialysis. More recently, his analysis of an aërolite, which he found to be partly composed of hydrogen, afforded an interesting confirmation of the results obtained by spectrum analysis as to the constitution of heavenly bodies. His "Elements of Chemistry" is a standard work, and has had a large circulation both in England and Germany, the German translation being edited by Professor Otto, of Brunswick. In 1836, Mr. Graham became a Fellow of the Royal Society. In 1848, he was elected a Corresponding Member of the Academy of Sciences of the Institute of France; and, in 1855, the University of Oxford conferred upon him the honorary degree of D.C.L. The loss of the deceased *savant*, who was a bachelor, will be very seriously felt in the scientific world and also at the establishment of which he was the head, where he has rendered eminent service to the nation at large by the introduction of many great improvements.

The Whitworth Scholarships.—The following candidates have been reported to the Science and Art Department as entitled to the ten Whitworth scholarships of £100 a year each:—William H. Greenwood, aged 23, engineer, student at the Mechanics' Institution, Manchester, 143 marks; Thomas A. Hearson, aged 23, engineer, student, Royal School of Naval Architecture, 137 marks; John Hopkinson, B.Sc., aged 19, student at Cambridge University, 134 marks; Thomas S. Elgood, aged 24, mechanical engineer, Leicester, and Owen's College, Manchester, 127 marks; George A. Greenhill, aged 21, student at Christ's Hospital School and Cambridge University, 116 marks; John R. Brittle, aged 23, engineer, student at Sir Walter St. John's School, Battersea, 113 marks; Thomas W. Phillips, aged 23, student at British School, Millwall, and Royal College of Science, Dublin, 100 marks; Richard Sennett, aged 21, engineer, student at the Royal School of Naval Architecture, 98 marks; Robert B. Buckley, aged 21, engineer, student at Merchant Taylors' School, 97 marks; Charles E. Leeds, aged 23, B.A. (Oxon.), student at Oxford University, 96 marks.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of every chemical paper in the world, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers on a level with the latest advances of science.*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Journal für Praktische Chemie, No. 10 (*Continued.*)

Sulphoxybenzoic Acid.—M. Senhofer.—The author

has prepared this acid, and many of its salts, in pure state. Referring to some by-products, among which is protocatechusic acid, the author also discovered some non-crystallisable compounds, which are intermediate between benzoic and paraoxybenzoic acids, on the one hand, and protocatechusic acid on the other. Analogous products are obtained when anhydrous phosphoric acid acts upon eugenol and bitter oil of almonds.

Protocatechusic Acid.—Dr. Malin has prepared this acid from sulpho-anisic acid, and obtained from about 12 to 15 per cent of very pure protocatechusic acid. The author intends to obtain from this acid methyl and ethyl derivatives.

Violet Pigment.—Professor Hlasiwetz.—The author obtains from binitrated naphthol, by means of the reducing action of cyanide of potassium, a beautifully violet-coloured pigment, which has great similarity with indigo. No particulars are given about this discovery, neither about the process by which this substance is obtained. This very brief and imperfect notice is only intended *pour prendre date.*

Iodbenzyl.—M. A. Lieben.—When hydriodic acid acts, at the ordinary temperature, upon chloride of benzyl, iodbenzyl only is formed; this is a solid, crystalline substance, fusing at 24°. Since this body is very ready to undergo double decomposition, it is very suitable for the preparation of benzyl compounds.

Action of Hypochlorous Acid upon Butylen.—M. A. Lieben.—The author says:—The chief product of this action is butylen-chlorhydrin; when this is treated with water and an amalgam of sodium, a butylic alcohol is formed, which, on oxidation, yields acetic acid. That alcohol is, therefore, ethyl-methyl-carbinol, and is identical with the alcohol which is obtained from butylen and hydriodic acid and subsequent saponification.

Solubility of Carbonate of Lime in Water Saturated with Carbonic Acid.—M. A. Cossa.—A great many years ago, Professor Bischof, at Bonn, called attention to the fact that the state of aggregation had a great influence upon the solubility of carbonate of lime in water saturated with carbonic acid. The author has studied this subject, and, starting with pure white Carrara marble, has extended his researches over a dozen varieties of carbonates of lime, including chalk, Iceland spar, dolomite, oölithic limestone, and artificially-prepared carbonate of lime. The chief results are as follows:—1000 parts of water, saturated with carbonic acid at the atmospheric pressure (reading of barometer) at the time of the experiment, and at temperatures varying from +7·5° to 28°, dissolve of Carrara marble—at from 7·5° to 9·5°, 1·181 parts; at from 20° to 22°, 0·9487 parts; of Luneberg chalk, 0·835 parts; of artificially-prepared (precipitated) carbonate of lime at 18°, 0·950 parts: of oölithic limestone, 1·252 parts at 15°; of dolomite, from Monticello, 0·573 parts at 15°.

No. 11, 1869.

This number opens with a brief notice of the death of one of its editors, the late Dr. Gustav Werther, Professor of Chemistry at the University of Königsberg, Prussia.—The deceased was born at Rossla, on the Harz, on the 1st of August, 1815, and died, on the 29th of June last, at Königsberg. For fully seventeen years the deceased was one of the editors of this periodical.

This number contains the following original papers:—

Researches on Fergusonite.—M. Hermann.—Under the name of fergusonite, such minerals are known as are chiefly made up of an acid of one of the niobium metals and yttria, and belong to the tetragonal system of crystals. These minerals have been found as yet only in Greenland; in Sweden, near Ytterby; in Norway, near Arendal; and a few other localities in these countries. Since Mr. Forbes found alumina and water in two kinds of the fergusonite found near Hampemyr, and since the Greenlandic mineral does not contain these substances, Mr. Forbes believed that these Norwegian fergusonites were peculiar minerals, and named them tyrite and bragite. The author of this paper states that other chemists did not find any alumina in these fergusonites, while the quantity of water was found to vary between 1 and 6·44 per cent. As regards the substances designated as niobic acid, several quite different compounds are named; for instance, the niobic acid of the Columbites is (TaO_2,NbO_2,IlO_2); the niobic acid of Æschynite is (NbO_2,IlO_2); the niobic acid of Samarkite consists of (IlO_2,TaO_2,TiO_2), and, moreover, of a peculiar metallic acid as yet but imperfectly known. The author has tried to elucidate these matters, and has analysed a sample of very pure fergusonite from Hampemyr; the sample selected weighed 360 grains, and was imbedded in granite. After having been separated from its matrix, this mineral exhibited a glassy lustre; colour, brownish black; in powder, cinnamon-brown; hardness, 6; sp. gr., 5·31. When heated in a small flask, the mineral decrepitates and gives off water. After having lost its water, the mineral could not be fused when held between platinum-pointed forceps in the flame of a spirit-lamp. On being thus heated, the colour of the mineral changes to yellow; heated before the blowpipe-flame with borax, the reaction of uranium is exhibited; loss on ignition, 3·75 per cent of water. The not-previously-ignited mineral is readily fused and disintegrated with bisulphate of potassa. The metallic acid of the fergusonite from Hampemyr consists, according to this author's researches of two atoms of niobous-niobic acid and one atom of ilmenous-ilmenic acid. In 100 parts, this mineral consists of:—Stannic acid, 0·06; niobous-niobic acid, 29·56; ilmenous-ilmenic acid, 13·82; titanic acid, 0·67; zirconia, 4·02; thoria, 3·44; oxide of cerium, 0·77; yttria, 37·15; protoxide of uranium, 3·43; protoxide of iron, 1·43; lime, 1·90; water, 3·75; and traces of protoxide of manganese and oxide of lead. The author, in this very extensive and exhaustive essay, quotes a large number of analyses of various species of this mineral, but space forbids to enter into more details on this subject.

Researches on the Composition of Samarkite, and Observations on the Chemical Constitution of the Niobium Metals.—M. R. Hermann.—The author states that, though there are a large number of analyses of samarkite in existence, these analyses are, in this aspect, imperfect; that, at the time they were made, the more delicate methods for estimating small quantities of tantalic, niobic, and ilmenic acids were unknown. The author then reviews, at length, the labours of various chemists and mineralogists on this subject; and next enters, at great length, into very minute details of methods of analysis. The chief result of his researches, as regards samarkite, gives, for that mineral, the following percentage composition:—Stannic acid, 0·35; titanic acid, 4·94; tantalic acid, 3·40; ilmenous-ilmenic acid, 24·57; a peculiar acid, 26·61; thoria, 4·47; yttria, 14·00; protoxide of uranium, 10·58; protoxide of iron, 10·70; magnesia, 0·34. The author next enters into lengthy particulars about some minerals which are homo-morphic and poly-morphic with samarkite. The paper ends with an essay on the constitution of the niobium metals.

Water of the Hydrosilicates.—Dr. F. von Kobell.—The author begins with some observations on water of crystallisation and so-called basic water. He next calls attention to the fact that the silico-hydrates of magnesia, and some minerals, as, for instance, prehnite, euklase, and others, contain water, which is only expelled by long-continued and strong ignition. Dr. Rammelsberg has suggested that this so-called basic water is not contained in the minerals as water, but exists therein as hydrogen and

oxygen, and is only formed, combined, when the ignition takes place; but the author thinks that this opinion does not explain sufficiently the reason why the water of the hydrosilicates should be expelled so difficultly and unequally by heat. Since the oxides of different metals behave differently when submitted to heat in respect of giving off part or whole of their oxygen, the author of this memoir thinks that a somewhat similar cause may operate in respect of the more or less readiness wherewith minerals part with their so-called basic water. In this, however, should be taken into account the time the heat acts, and the degree to which it is applied. In this latter respect, the author has made some experiments with a few minerals, submitting them, first in lumps, next in powder, and in weighed quantities, repeatedly for a known time to the same degree of heat. A piece of analcime weighing 4·74 grms. did not lose all its water after four ignitions, while the same weight of the same powdered mineral lost its water entirely after three ignitions, all of the same duration of time.

On Aspidolite.—M. von Kobell.—This mineral—the hardness of which is about 2; sp. gr. 2·72—consists, in 100 parts, of:—Silica, 46·44; alumina, 10·50; magnesia, 26·30; protoxide of iron, 9·0; soda, 4·77; potash, 2·52; water, 1·13.

Paragonite from Virgenthal, Tyrol.—M. von Kobell.—There occurs, at Virgenthal, a greenish-coloured mineral, which has great likeness to nephrite, and is applied for ornamental purposes, after having been cut and polished. The sp. gr. of this mineral is 2·9. In 100 parts, it consists of:—Silica, 48·00; alumina, 38·29; peroxide of iron, 0·91; soda, 6·70; potassa, 1·89; magnesia, 0·36; water, 2·51.

On Atractylic Acid.—M. Lefranc.—This acid occurs in the root of the *Atractylis gummifera* in the shape of atractylate of potassa, which may be obtained from the root by exhausting it with boiling water, evaporating this solution, and taking up the residue with alcohol of 85 per cent, purifying with animal charcoal, and recrystallisation from alcohol. The atractylic acid is obtained in free state by decomposing the potassa salt with acetate of lead, and by next decomposing the atractylate of lead thus formed with dilute sulphuric acid. The atractylic acid so obtained is a colourless fluid, having a sour, but, at the same time astringent, bitterish-sweet taste; reddens blue litmus-paper; is not precipitated by chloride of barium; cannot be obtained in concentrated form; and is decomposed on being boiled and converted into sulphuric and valerianic acids, sugar, and resin. Formula, $S_4O_{12},C_{60}H_{92}O_{20}$.

Naphthalin and Anthracen (Paranaphthalin).—Dr. Vohl.—The author calls attention to the naphthalin and anthracen manufactured by Messrs. Gerhartz & Co., at Cologne. These gentlemen have succeeded, by means of an improved method of manufacture, in obtaining the two substances just named in perfectly pure state, and in solid bars or discs, akin to those of white wax. The author has tested these substances, and found them to be quite free from creosote and oily matters. The same firm also manufactures nitro-derivatives of these substances in pure state.

On Hartite.—M. Rumpf.—By this name is understood a peculiar hydrocarbon (C_5H_8), found some years ago near Glogguitz, among the coal of the Oberhart district. The author obtained a sample of this rather rare mineral from Voitsberg and Köflach, in Styria, and found that, crystallographically, this mineral belongs to the *triklinic system*. The elementary organic analysis of this specimen led to results giving the same formula as above stated. This mineral appears to occur among lignitic brown coal, and is evidently formed during the peculiar cremacausis the wood is subjected to.

Cresylo-Purpuric Acid.—Dr. von Sommaruga.—The author obtained this acid, $C_8H_7N_5O_8$, by a process which is not described in the brief notice given on this subject. The author states that, while studying the products of decomposition of trinitrocresylic acid and cyanide of potassium, he discovered, besides cresylo-purpuric acid, a peculiar compound, which, after having been purified, appears to exhibit great analogy with indigo in many respects. M. Hlasiwetz has obtained a somewhat similar compound from dinitronaphtol. Both authors are engaged in further researches on this subject.

Aminamides of the Fatty Acid Series.—Dr. Linnemann.—The author has particularly studied the behaviour of formamides—for instance, ethylformamide, prepared by him by means of a simple process, towards such substances as withdraw water from these bodies (*Wasserentziehende Mittel*). He found that carbylamines are not formed, as stated by Messrs. Chapman and Smith, but that carbonic oxide, carburetted hydrogen, and ammonia make their appearance. Ethylacetamide behaves in the same manner under the same conditions; but diacetamide, obtained by a peculiar process, not described in this notice, is decomposed into aceto-nitrile and acetic acid when acted upon by materials which are capable of withdrawing water from these bodies.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, May and June, 1869.

These two numbers have been published together, stitched in one cover.

We abstract from this the following original matter:—

Contribution to the History of Buxine.—M. Flückiger.—The author begins this paper with an historical introduction, going back as far as the year 1636. Next he discusses at great length the pharmacognostical differences of *Radix Pareiræ bravæ*, *Cissampelos Pareira*, *Botryopsis platyphylla*, and thereupon alludes to pelosine, an alkaloid discovered in 1838, by Dr. Wiggers, in the Pareira. This alkaloid the author assumes to be identical with bibirine. This latter alkaloid is stated to be identical with buxine, a substance discovered, in 1860, by Walz, in the leaves of the *Buxus sempervirens* (box-tree). Buxine, according to this author, is an alkaloid identical with those already named, and a substance not simply met with in the leaves and bark of the box-tree, but far more generally dispersed through the vegetable kingdom, and especially met with in the natural families of the Euphorbiaceæ, Laurineæ, Rubiaceæ, and others. Buxine is very difficultly obtained in a pure state, since it is naturally accompanied by a peculiar substance called buxoflavine. Buxine is characterised by the property that its concentrated solution in hydrochloric acid is precipitated by nitrate of potassa, chloride of ammonium, and iodide of potassium, which latter salt precipitates even the dilute solutions of buxine copiously.

The Colouring Matter met with in the Common Buckthorn Bark.—M. Faust.—After reviewing the labours of Messrs. Ferber, Binswanger, Buchner, Casselmann, and others, on this subject, the author states that frangulin is the chief active principle of the bark in question. Frangulin is a glucoside; its formula is $C_{20}H_{20}O_{10}$; it fuses at 226°; is soluble in alkalies, exhibiting a beautifully purple coloured solution. When the alcoholic solution of frangulin is boiled with one-third of its bulk of hydrochloric acid, this material is split up into sugar and frangulinic acid, $C_{14}H_{10}O_5$. This acid crystallises, exhibiting yellow-coloured crystals; readily soluble in alcohol and ether, but very difficultly so in water; also readily soluble in dilute aqueous solutions of alkalies, and in ammonia exhibiting a magnificent red colour. The acid fuses at about 249°. Acids precipitate from the alkaline solutions of frangulinic acid the latter acid in unaltered state.

Researches on Hydroborocalcite.—Dr. Graeger.—The author says about twenty-five years have elapsed since M. Hayes discovered, near Ibique, in South America, a borate of lime, which, according to his researches, consisted, in 100 parts, of:—Lime, 18·89; boracic acid, 46·11; water, 35·00. Since the time this analysis was made, the mineral locally known as teza has become an article of commerce, and is brought over to Europe with the view of being applied to the manufacture of boracic acid and borax. According to the author, this mineral, which is chiefly found in nodules among the nitrate of soda beds of Peru, when dried at 100°, has, in 100 parts, the following composition:—Borate of lime, 52·39; borate of soda, 10·23; sulphate of soda, 1·06; chloride of sodium, 3·76; residue insoluble in acid, 4·23; water, 28·33.

The Manufacture of Borax from the Native Borate of Lime.—Dr. Graeger.—The author states that, since he found that what is stated in treatises and handbooks on chemistry concerning pure borate of lime is generally quite erroneous, he commenced by studying the properties of that substance more minutely. Pure borate of lime is only slightly soluble in pure water, 100 parts of which, at about 18°, only dissolve from 0·304 to 0·333 parts of that salt; boiling water does not dissolve, perceptibly, more of this salt. A solution of pure borate of lime in water behaves, with the following reagents, in the following manner:—Ammonia, no precipitate; caustic potassa solution, very slight precipitate, due to a trace of carbonate present along with the caustic alkali; carbonate of ammonia, copious precipitate, soluble in excess of precipitant; carbonates of potassa and soda, permanent precipitates; neither the nitrate of protoxide, nor of peroxide of mercury, nor, also, neutral chloride of iron, exhibit any reaction with the solution in question; solution of sulphate of copper gives a greenish blue precipitate. Since borate of lime is less soluble, even in alcohol, than sulphate of lime, a solution of the former salt in water containing only 1ocoth part of the salt is readily precipitated by alcohol containing 60 per cent of absolute alcohol. The presence in solution in water of some salts, especially chloride of sodium and ammonium, largely increase the solubility of borate of lime in water. Such acids as form with lime readily soluble salts, do readily dissolve borate of lime, both pure and native; and from such solutions, if concentrated, boracic acid is precipitated. The portion of this paper relating to the manufacture of borax and boracic acid from the native borate of lime alluded to, is rather a practical receipt for the proper performance of this branch of industry, and, therefore, not well suited for abstraction, the less so as the price of fuel, soda, and other things necessarily influence the applicability of the borate of lime for that purpose.

Glycerine as a Substitute for Spirits of Wine for the Preservation of Zoological and Anatomical Preparations.—Dr. Koller.—The author recommends concentrated glycerine as being cheaper, not liable to evaporation, not combustible, and, moreover, as better preserving the natural colour of various preparations usually kept and preserved in spirits of wine. According to the author, glycerine answers this purpose eminently.

A New Method of Fusing Difficultly Decomposable Minerals.—Dr. Vorwerk recommends that 1 part of the previously very finely-powdered mineral should be mixed with 3 parts of fluoride of sodium, and that this mixture, after having been placed in a platinum crucible, should be covered with 12 parts of powdered bisulphate of potassa. Minerals such as chrome iron ore, hard hæmatite, tin ores, and rutile, corundum, and the like, are very readily brought to fusion and disintegrated by this flux, even with no more heat than that obtained from a good Bunsen gas-burner.

Sindor Oil and Sindor Balsam.—M. Maier.—These substances are used externally, in some diseases of the skin, by the Javanese. The real sindor tree belongs to Borneo, and is called there pohonsinampar. The balsam investigated by the author has the consistency of balsam copaivæ, and exhibits a smell not unlike the latter substance; sp. gr. at 27·5°, 0·9221. The sindor balsam boils at 255°; burns, when heated to a higher temperature, with a flame emitting much soot and smoke; on being distilled along with water, the balsam left a reddish brown-coloured transparent resin. The balsam is difficultly soluble in alcohol, and on being brought into contact with strong sulphuric acid, became blood-red coloured. The essential oil, obtained by distilling the balsam with water, was of a light yellow colour, very fluid, boils at between 245° and 250°; sp. gr. at 27°, 0·914; soluble in from 4 to 5 parts of cold, and from 1 to 1½ parts of hot alcohol. The author extended his researches to other balsams, which, though bearing the same name, are evidently either obtained from different trees, or have undergone peculiar preparations whereby their physical and chemical properties are very much altered. As to the trees yielding these balsams, the eminent botanist, M. Teysmann, who has resided for upwards of forty years in Java, states that they are not precisely known.

Distinction between Gum Arabic and Gum Senaar.—M. Schlosser.—According to the author, these two kinds of gum are not, as generally supposed, different only in quality from each other, but the senaar gum is undoubtedly derived from another tree. The behaviour of these two kinds of gum with acetate of lead is, according to the author, a ready means of distinguishing between the two with certainty; take 3 grms. of pure gum arabic, dissolve in 15 grms. of water, add gradually, and while stirring the mixture, 30 grms. of acetate of lead (from the wording in the original, it is impossible to infer whether an aqueous solution is meant or the dry salt in powder) there thus ensues a whitish precipitate, forming a rather thickish magma, which is transferred to a filter, the filtrate, about 18 to 20 grms., running off, exhibiting a hardly even opalescent fluid; the filtration is finished in an hour's time, and the residue left on the filter is no more fluid; take about 6 grms. of the filtrate, add 5 grms. of pure water and 1½ grms. of liquid ammonia, specific gravity 0·960, the fluid will remain quite clear, and even if, after twelve hours' time, a sediment were deposited, this does not amount to more than ¼ c.c. When gum senaar is treated in the same way it yields a milky filtrate; the filtration is extremely slow, and even after twenty-four hours the substance on the filter appears fluid. When 6 grms. of this filtrate are treated precisely as just described, the contents of the test tube, on being shaken about, become solidified, exhibiting a gelatinous mass.

A New Preservative Against Fire.—M. Reinsch.—The author states that, having been requested to report to a fire insurance company about the best means of preventing timber bursting into flame, he experimented with various salts, and at last came to the conclusion, as the result of his experiments, that impregnating timber with a concentrated solution of rock salt is as good, if not better, a preservative against its bursting into flame as water glass (silicate of soda), while the price of the former salt is, of course, only a mere trifle; moreover, rock salt thus applied to timber is a preservative against dry rot and noxious insects. The author recommends the use of salt water, that is to say, a solution of rock salt of moderate strength for the use of fire engines during a fire as by far more effective than water; but in order that the salt should not injure the working parts of the engines, they will immediately afterwards have to be played with fresh water again.

Cosmos, August 28, 1869.

This number contains, amongst its very varied information, the following:—

What becomes of Old Shoes.—They are cut up in small pieces, and these are put for a couple of days in chloride of sulphur, the effect of which is to make the leather very hard and brittle. When this is found to have been

effected, the material is withdrawn from the action of the chloride of sulphur, washed with water, dried, ground to powder, and mixed with some substance which causes it to adhere together, for instance, shellac or any other resinous material, or also good glue or thick solution of gum; it is then pressed into moulds and shaped into combs, buttons, knifehafts, &c.

The Poisoned Fountain.—In La Limagne, Département Puy de Dôme, France, carbonic acid is nearly everywhere given off in smaller or larger quantity from the limestone formation which occurs there. Near Aigueperse, a town in the Département just named, a locality exists which is popularly named the "poisoned fountain;" it consists of a round hole placed in a depression of the soil, and this hole contains somewhat turbid water, from which carbonic acid constantly escapes, accompanied by a noise as if steam were blowing off from the safety valve of a steam boiler. It often happens that birds and other animals which come near this hole to drink from the water it contains, are asphyxiated at once by the carbonic acid. Such sources are often found in volcanic districts; near Naples the well-known "Grotto del cane" occurs, and the "Death valley" in the island of Java is the most extensive instance of this kind known.

Comptes Rendus des Séances de l'Académie des Sciences, August 16, 1869.

This number contains, among a large number of purely mathematical, mathematico-physical, and papers on other subjects not at all allied to chemistry, the following memoirs:—

Constitution of Luminous Spectra.—M. Lecoq de Boisbaudran.—The author says, in the year 1865, I stated "that, when the spectral rays of the metals of the alkalies and alkaline earths are classified according to their refrangibility, they are placed according to the chemical properties and the atomic weights of these bodies." The author now says—"I can explain the formation of the spectra by the four following points:—1st, the molecules should present certain inequalities, and should not be solids rotating round a circular axis; 2nd, they must be in rapid motion; 3rd, that motion ought to be an eccentric elliptic; 4th, the ellipse itself should move in a perihelical manner. From the combination of the spherical and elliptical movements, I can explain the formation and the entire mode of existence of a spectrum; that is to say, groups which are repeated in several points of the luminous part, shadowed rays or stripes decreasing either towards the right or left hand, and repetition of these stripes in the spectrum."

Researches on the State Salts are in when Dissolved in any Menstruum.— MM. Berthelot and St. Martin.—The authors find—1st, that there do not exist in solution acid salts formed by a monobasic acid; 2nd, the acid salts formed by a bibasic acid are, when in solution, partly decomposed; 3rd, the quantity of salt thus decomposed increases steadily and continuously when dilution takes place; 4th, the quantity which is decomposed varies according to the relation existing between the neutral salt and the excess of acid; the stability of the acid-salt is increased by the presence of a neutral salt, or by the presence of excess of acid. The authors have, moreover, found that—1st, the acetates of the alkalies are entirely decomposed, when in aqueous solution, by sulphuric, hydrochloric, oxalic, and even tartaric acids; 2nd, ammonia, when added to solutions of acetate or oxalate of potassa, or soda, in solution, does not seize upon any of these acids; 3rd, oxalic acid partly decomposes a solution of chloride of sodium, when, in a litre of water, 14 grms. of oxalic acid and 20 grms. of chloride of sodium are dissolved (larger quantities of these substances cannot be taken, on account of the difficult solubility of binoxalate of soda). The authors found that about 1-10th of the oxalic acid was converted into binoxalate of soda.

Fermentation of Fruit.— MM. Lechartier and Bellamy.—In this paper the authors relate their experiments whereby they discovered that fruit—apples and pears, more especially—when kept, gives off carbonic acid; but, at the same time, in the interior of the fruit, alcohol and acetic acid are formed. We quote the following figures:—Duration of experiment, 184 days; weight of apples, 348·8 grms.; loss of weight, 14·3 grms.; loss of sugar, 26·0 grms.; gas given off, 13·10 grms.; alcohol formed, 10·01 grms.; acetic acid formed, 0·11 grm. From these and some other experiments made by the authors, it appears that fruit of the kind alluded to is best and most advantageously kept so as to admit of free circulation of air round every individual fruit as much as possible. To keep fruit in closed vessels causes rapid destruction.

On Bromotoluen and the Toluidines derived therefrom.—MM. Rosenstiehl and Nikiforoff.—This paper is a critical review of the labours of MM. Koerner, Huebner, and Wallach, and not suited for abstraction.

On Propylamine.—M. Silva.—The substance obtained by this author, by means of a complicated process, is a liquid exhibiting a strongly ammoniacal smell; very alkaline, inflammable, precipitating solutions of alumina, and re-dissolving the precipitate thus formed; also precipitating solutions of salts of magnesia, nickel, cobalt, and iron; boiling point about 50°; vapour density referred to air, 2·01; specific gravity at 0°, 0·7283; formula—

$$\left.\begin{matrix}(CH_3—CH_2—CH_2)\\ H\\ H\end{matrix}\right\} N.$$

In 100 parts:—C, 61·01; H, 15·26; N, 23·73. The author has studied some of the salts this basis forms.

Constitution of Pseudotoluidine.— M. Koerner.—The author discusses in this paper the correctness or incorrectness of certain results published on this subject by M. Rosenstiehl. The paper is full of formulæ and not well suited for abstraction.

Testing the Antiquity of Manuscripts by means of Studying the Age of the Ink Employed in Writing it.—M. Gaultier de Claubry.—The chief result the author points to is that M. Carré's method alluded to by us in a former number of an abstract of this periodical, is entirely unfit to be used as a test for indicating the age of any writing.

Synthesis of Crotonic Aldehyde.—MM. Paterno and Amato.—The authors have tried, but in vain, to prepare this aldehyde by heating, in sealed tubes, aldehyde and chloride of ethyliden. The reason that they publish this, as they themselves confess, very imperfect work, is due to the publishing of the results of experiments on this subject by M. Kekulé.

Preservation of Stone from the Ravages of Cryptogamic Plants by means of the Oxide or Salts of Copper.—M. Robert.—The gist of this paper is, that the pedestals upon which are placed statues made of bronze, or to which copper ornaments are added, are protected by the salts of copper which are gradually formed under the influence of wind and weather; and these salts, being washed down by rain, prevent, by their poisonous action, the formation of small cryptogamic plants, and hence, also, prevent the decay and deterioration of the stone. The author thinks that salts of copper, or copper or bronze ornaments, might be applied successfully to pedestals, as well as buildings, in order to preserve the stone they are made of from decay, the chief cause of which is, according to the author, the growth of minute cryptogamic plants.

We learn from this number that, on the 8th of April last, the Imperial Academy of Sciences of St. Petersburg appointed a committee with a view of propounding measures to be taken in order to submit to an international committee several questions relating to the making of standard weights and measures according to the decimal system. The report of that Russian committee was read at this meeting of the French Academy, and gave rise to a lengthy discussion. The chief

points of the Russian report may be briefly stated as follows:—That steps be taken by the Academy of St. Petersburg to induce the Russian Government to use its influence to invite a meeting of delegates of all foreign states, in order to discuss and regulate everything requisite to the proper manufacture of standard weights and measures according to the decimal system; the place of meeting to be afterwards designated; and that M. Jacobi be requested to bring this matter before the meeting of the British Association for the Advancement of Science, at Exeter, and be also requested to urge the necessity of the general adoption of the metrical system by all men of science in all countries.

Bulletin de la Société Chimique de Paris, August, 1869.

From the abstracts of the *procès verbaux* of the meetings of this Society, held on the 4th and 18th of June last, and published with this number, we learn that M. Longuinine spoke about his—

Researches on Birch-Wood Tar.—When this tar is distilled along with water, there is obtained a light, yellowish-coloured oil, which, on being treated with caustic potassa, yields a crystalline compound, due to a peculiar phenol, which constitutes about 1-15th of the entire quantity of oil obtained. The remainder of this oil yields chiefly tereben, boiling and distilling over between 160° and 180°. The phenol obtained exhales the peculiar and well-known smell of Russian leather, chiefly employed for bookbinding purposes.

M. Friedel spoke on the—

Formation of the Chlorides of Acids.—Anhydrous phosphoric acid does not, at 0°, act upon crystallised acetic acid; when this mixture is treated with dry hydrochloric acid gas, chloride of acetyl is formed.

M. Joffre communicated the composition of a native crystalline carbonate of soda found in Fezzan (a great oasis in Tripoli, Africa); this salt is a sesquicarbonate, $2NaO,3CO_2+4HO$.

M. Thiercelin called attention to the formation of the saltpetre beds on the coast of Peru, and states that the beds situated close to sources of water impregnated with common salt are yet quite free from iodine.

M. Bouchardat said that, according to his experiments, cinchonine fuses at from 256° to 262°. Kept at an elevated temperature in a current of carbonic acid, this base begins to volatilise, without decomposition, at 275°; when, however, cinchonine is kept for a length of time at 150°, it is converted into liquid volatile bases.

This number contains the following original papers:—

Synthesis of a New Butylen, Ethyl-Vinyl.—M. Wurtz.—The author mixes zinc-ethyl and bromide of ethylen, heats in a sealed tube up to 140° for some hours, and next leaves the tubes quietly standing for several weeks. Previous to opening the tubes, they are placed in a strongly-cooling mixture, and arrangements made to collect the gas which may escape on opening the tubes into bromine. After proper purification, the bromide obtained constitutes a perfectly colourless liquid boiling at about 166°; sp. gr. at 0°, 1·876. The ethyl-vinyl obtained from this bromide boils at 5°; and, on being re-converted again into a bromide, that latter compound boils again at 166°.

Synthesis of Aromatic Acids.—M. Wurtz.—The method described by the author consists in treating an organic chloride or bromide with chloroxycarbonic ether and sodium-amalgam. In this way, the chlorine or bromine seized upon by the sodium-amalgam is replaced by $CO_2(C_2H_5)$. The author has applied this method in some instances, and thus prepared benzoic ether according to the following formulæ;—

$$C_6H_5Br + CO\left\{\begin{matrix}O,C^2H_5\\Cl\end{matrix}\right. + Na^2 - NaCl + NaBr + C_6H_5,CO_2(C_2H_5).$$

Bromide of ethyl. Chloroxycarbonic ether. Benzoic ether.

Researches on the Propylic Alcohol of Fermentation.—Dr. G. Chaucel.—This lengthy and very concisely written paper, full of formulæ, does not admit of suitable abstraction.

Ethylic Series of Silicium.—MM. Friedel and Ladenburg.—The authors describe in this paper, at great length, their experiments to obtain compounds wherein silicium replaces one or more atoms of carbon. Silicium-ethyl, $Si(C_2H_5)_4$, is a liquid boiling at from 150° to 154°. Silicium-hexethyl, $Si_2(C_2H_5)_6$, is also a liquid, readily inflammable, and giving off, while burning, fumes of silica; vapour density, 7·96.

On Acetochlorhydrine and Octylglycol.—M. de Clermont.—Acetochlorhydrine of octylen is a liquid, insoluble in water, soluble in alcohol, ether, and acetic acid; rather readily inflammable, and burning with green-bordered flame; boiling point, 225°; sp. gr. at 0°, 1·026. Composition, in 100 parts:—C, 58·11; H, 9·20; Cl, 17·19.

Some New Ferrocyanides and Ferricyanides.—M. Wyrouboff.—This paper is chiefly a critical review of the labours of M. Riendel published in a German periodical some years ago. This author's paper is too lengthy, and too much filled with a large number of formulæ, to admit of useful abstraction.

Analysis of a Native Carbonate of Soda.—M. Joffre.—Composition, in 100 parts:—Soda, 39·41; carbonic acid, 39·58; water, 19·52; sand, 0·53; oxide of iron, 0·01; carbonate of lime, 0·05; chloride of sodium, 0·46; sulphate of soda 0·44. This salt, therefore, belongs to the mineralogical species known as urao.

Action of Hydrogen upon Acetylen when Platinum Black is simultaneously present.—M. de Wilde.—The author finds that, when acetylen and hydrogen, both chemically pure, are brought together, at the ordinary temperature, in a space wherein platinum-black is placed, hydride of ethyl is formed—

$$C_2H_2 + 2H_2 = C_2H_6.$$
$$2 \text{ vols.} \quad 4 \text{ vols.} \quad 2 \text{ vols.}$$

When less hydrogen is applied, it appears, says the author, that ethylen is formed.

Acetic Derivatives from Mannite.—M. Grange.—This paper and the following—

Acetic Derivatives obtained from Amylum Gum and the Hydrocarbonates (MM. Schutzenberger and Naudin), have been already briefly abstracted from the *Comptes Rendus*, a remark which equally applies to—

Butyrate and Valerate of Isopropyl (M. Silva) and—

New Sulphur Acid.—M. Schutzenberger.

Researches on the Ethers of Phenol.—M. Lipmann.—Ethylendiphenol, obtained by the author by a complicated series of operations, is, when pure, a solid substance, fusing at 95°, insoluble in water, readily soluble in chloroform, and also in boiling alchol; formula—

$$\left.\begin{matrix}(C_6H_5)_2\\C_2H_4\end{matrix}\right\} O_2.$$

Ethylen-diphenol sulphuric acid; the lead- and barium-salt of this acid have been studied, the former has the following formula:—

$$\left.\begin{matrix}(C_6H_4SO_2)_2Pb''\\C_2H_4\end{matrix}\right\} O_2.$$

Tetrabromide of ethylen-diphenol is a solid substance, crystallising in small needles, fusible at a little above 100°. The real constitution of ethylen-diphenyl is, according to this author—

$$C_6H_5CH_2,C_6H_5CH_2.$$

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 12, 1869.

This number contains the report of the meeting of this Society, held under the presidency of Dr. A. W. Hofmann, on

the 28th of June last. From the *procès verbal*, we learn that a committee has been formed for the purpose of erecting a simple, yet appropriate, memorial tombstone on the grave of the late Dr. F. F. Runge, who died at Oranienburg, near Berlin, on the 25th of March, 1867. The deceased was well and deservedly known, and well deserved from science and industry this posthumous memorial of services rendered.

The following papers were read:—

Chlorides of Carbon.—M. H. Kolbe.—Through the kindness of Dr. Marquart, the celebrated practical and operative chemist, and owner of chemical works at Bonn, the author has obtained a large quantity of the solid sesquichloride of carbon, C_2Cl_3. (To some of our readers the fact may be of interest to learn that this preparation has been used with comparative success in the worst forms of Asiatic cholera). This substance is readily converted into the fluid chloride of carbon, C_2Cl_4, by means of the action of zinc and sulphuric acid, although there is simultaneously formed a compound, C_2HCl_3. Since the compound C_2Cl_4 enjoys the property of combining directly with chlorine and bromine, the author thought it might be possible to make that compound enter directly into combination with two atoms of hyponitric acid. This nitro compound, $C_2Cl_4(NO_2)_2$, is prepared when the simple chloride of carbon, C_2Cl_4, is mixed with hyponitric acid, kept very cold by means of cooling mixture, and next heated in a sealed tube at from 110° to 120°. The quantity of dinitro-perchloride of ethylen, or dinitro-chloride of carbon, thus obtained is rather small in quantity since, during the preparation, a mass of by-products are formed, among which is chlorocarbonic oxide. The substance alluded to is a solid volatile body, soluble in alcohol and ether, insoluble in water, crystallises like the sesquichloride of carbon, and, like that substance, cannot be reduced to powder. This compound cannot be fused without decomposition. The elementary analysis gave results leading to the formula $C_2Cl_4(NO_2)_2$.

Compound of Ethylen and Nitric Acid.—M. Kekulé.—The author has caused pure nitric acid, and, next, a mixture of nitric and sulphuric acids, to act upon ethylen. In the first instance, a large portion of the ethylen is destroyed by oxidation; but, with great care, and the application of strongly-cooling mixtures, an oily fluid was obtained, on addition of water in small quantity. Large quantities of this oil were obtained when ethylen was made to pass through a mixture of nitric and sulphuric acids, kept cold by means of very cold water. The substance obtained is, after purification, a colourless oily liquid of 1·472 sp. gr.; its vapour attacks the eyes, and causes headache; it is not volatile with decomposition. Far below its boiling point this substance is decomposed, giving off red vapours; even when water is present, the distillation is impossible without the simultaneous formation of nitrous acid, deutoxide of nitrogen, oxalic acid, glycolic acid, and some glyoxylic acid. The same decomposition takes place when this compound is boiled with solutions of alkalies. The author assigns to this body the empirical formula, $C_2H_4N_2O_5$, but he considers it to be an ether of glycol—

$$\left.\begin{matrix} NO \\ \| \\ C_2H_4 \\ NO_2 \end{matrix}\right\}O$$

Phenol-Sulphuric Acid and Nitro-Phenol-Sulphuric Acid.—M. Kekulé.—The author observes that he was the first who pointed out the fact that, when phenol and sulphuric acid act upon each other, there are formed two isomeric sulpho acids, para-phenol-sulphuric acid and meta-phenol-sulphuric acid. Since there have been different experimenters on this subject, some of whom have altogether overlooked this meta acid, and since the author has found that, with different modes of preparation the quantity obtained of this acid varies greatly, he instituted some experiments to ascertain under what conditions either of the two isomeric modifications are chiefly formed. The result obtained is that, when a mixture of phenol and sulphuric acid is left quietly standing at the ordinary temperature, it contains, not only at first, but for weeks after, chiefly the meta acid. When the mixture is heated, the quantity of the para acid increases, and continues to do so until, when the temperature is for some time kept at from 100° to 110°, the para acid only is present in the mixture. When the meta acid, obtained in pure state from its salts, is heated for some time on a water-bath, it is thereby entirely converted into the para acid. As regards the nitro-phenol-sulpho acid, the author found that there does not exist any doubt that, by whatever method this acid is prepared, the product obtained is always identically the same.

Artificial Alizarine.—MM. Graebe and Liebermann.—The authors say the publishing of their French patent on this subject makes it necessary not to delay any further the completion of their brief paper read before this Society, on the 11th of January, on the preparation of alizarine from anthracen. The authors, at the same time, state that, since they reserve their right of publishing full details of experiments and analysis on this topic, they only read a brief, rough, outline sketch. They succeeded in reducing alizarine obtained from madder to anthracen; and, suspecting that alizarine is a chinon acid, the idea of obtaining alizarine artificially became a feasible matter, as may be learned from the following formulæ:—

$$\underset{\text{Anthracen.}}{C_{14}H_{10}.} \qquad \underset{\text{Alizarine.}}{C_{14}H_6\left\{\begin{matrix}(O_2)'' \\ (OH)_2.\end{matrix}\right.}$$

The affair rested upon the possibility of substituting in anthracen, for two atoms of hydrogen, the group $(O_2)''$, characterising the chinons; and, for two other atoms of hydrogen, two atoms of hydroxyl. Prof. Anderson, of Glasgow University, discovered that, when anthracen is treated with nitric acid, oxanthracen is formed; this is, according to the authors, the chinon of anthracen, (anthrachinon, $C_{14}H_8(O_2)''$). This substance is also obtained from anthracen, by means of other oxidising agents, as, for instance, bichromate of potassa, and sulphuric or acetic acids. The authors tried to introduce into this anthrachinon two atoms of bromine or chlorine, in order to be able, by this means, to obtain the two atoms of the hydroxyl group, which are wanted. Chlorine does not act readily upon anthrachinon; with bromine, the substitution ensues at 100°. When, therefore, anthrachinon is heated for several hours in sealed tubes placed in a water-bath, after addition of four atoms of bromine, it is converted into bibrom-anthrachinon, while hydrobromic acid is simultaneously formed—

$$C_{14}H_8(O_2)''+4Br=C_{14}H_6Br_2(O_2)''+2BrH.$$

This body is a solid substance, soluble in benzol, crystallising from that solution, or by sublimation, and exhibiting bright yellow-coloured needle-shaped crystals. On being heated with a thoroughly concentrated solution of caustic potassa to about 170° (at which temperature the reaction sets in), the mixture assumes a deep blue colour, and the mass becomes soluble in water, exhibiting thereby the well-known and beautifully violet colour of alizarinate of potassa; when an acid is added to this solution, alizarine is precipitated from it, in the shape of a reddish brown flocculent matter. The following formula exhibits the formation of alizarinate of potassa from bibromide of anthrachinon:—

$$C_{14}H_6Br(O_2)''+4KHO=C_{14}H_6(OK)_2(O_2)''+2KBr+2H_2O.$$

The authors next state that they discovered another method for the preparation of bibromide of anthrachinon, and its conversion into alizarine. Since the bibromide of anthracen is converted, by means of being heated along with nitric acid, into anthrachinon, according to this formula:—

$$C_{14}H_6Br_2+2NHO_2=C_{14}H_8(O_2)''+2Br+2NHO_2,$$

the authors suspected that tetrabromanthracen, $C_{14}H_8Br_4$, would be readily converted into bibromide of anthrachinon by the same means. On trying this experimentally, they found that their opinion proved correct. By treating the bibromide of anthrachinon thus obtained with a strong solution of caustic potassa, alizarine was again obtained. The authors positively state that the artificial alizarine thus ob-

tained is in every respect identical with that obtained from madder; this is, be it observed, the first instance of the preparation of a naturally-occurring vegetable colouring matter by artificial means.

Behaviour of the Salts of Silver towards Iodine.—M. Weltzein.—After referring to experiments made by himself in 1854 and 1860, on this subject, the author states:—(1) When iodine acts upon the nitrate of silver, no free oxygen is given off; (2) that, not the anhydride of nitric acid, but hyponitric acid, is obtained, the reaction being represented by—

$$3AgNO_3 + 3I = 3NO_2 + AgIO_3 + 2AgI.$$

The author further says that he hoped to obtain, by the action of iodine upon the acetate and benzoate of silver, the respective anhydrous acids, but failed, and next winds up his paper with a long series of formulæ, not deduced from his own experiments, but made up from theoretical reasoning. The formulæ are too complicated and lengthy to be quoted.

There follows in this number, under the title of Correspondence, letters written from London, from Zürich (Switzerland), and from Cambridge, U.S. M. Meister, secretary of the Chemische Harmonika, a chemical society established at Zürich, writes—"At our meeting on the 22nd of June last, MM. Merz and Weith communicated that, when powdered sulphur is strewed on the surface of boiling aniline, a strong evolution of sulphuretted hydrogen gas is observed, while a base containing sulphur is thereby formed. Other organic substances, as, for instance, acetanilide, glycerine, and naphthaline, are acted upon by sulphur in the same way at a higher temperature. When pure and dry hydrogen gas is made to pass through boiling sulphur, sulphuretted hydrogen gas is developed in large quantities."—Mr. W. Gibbs writes from Cambridge, U.S., communicating the results of some experiments made by him on the—

Action of Nitrites of Alkalies upon Uric Acid and Derivatives therefrom.—When uric acid is heated along with a solution of nitrite of potassa or soda, and sulphuric acid, a strong effervescence takes place, the uric acid is completely dissolved, and the fluid contains alloxan and alloxantin. On evaporation to dryness on a water-bath, parabanic acid is obtained, and very small quantities of two peculiar substances—one a red-coloured, the other a bright bluish fluorescent—both flocculent substances. When acetic acid is applied, instead of a mineral acid, the same phenomena are observed to take place; but the filtered solution deposits a very voluminous salt, which, if nitrite of potassa were applied to the experiment, is composed according to the formula $C_4H_2KN_3O_3$. The peculiar acid contained in this salt has been named stryphninic acid, from στρυφνος, bitter astringent, since the acid and its salts exhibit this taste. The formula of the free acid is $C_4H_3N_3O_2$; it appears to be monobasic, and all its salts, except the lead-salt, are soluble in water. The author read this paper, of which only a brief account is here given, before the National Academy of Sciences, the transactions of which are, we believe, regularly published.

Existence of Molecular Compounds in Gaseous State.—M. A. Naumann.—This paper, which is placed under the section of *Mittheilungen*, and is dated from Giessen, the 1st of July last, is a philosophical essay, and not well suited for abstraction.

We beg to remind our readers that during the months of August and September this periodical is not published.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 199, July, 1869.

The only paper relating to chemistry in this number is on the—

Use of Extracts of Madder in Calico Printing, and the Part each of the Different Pigments contained in Madder Plays in this Operation.—M. Schutzenberger.—The author begins by stating that, notwithstanding the discovery of aniline and other artificially-made colours (dyes), madder and its preparation yet occupy a first rank among dyes, and not only will continue to do so, but its use will become more extended. The author next reviews, at some length, the history of madder, and preparations obtained from it, during the last forty years, alluding to garancine, flowers, or bloom of madder, and commercial alizarine—that is to say, madder submitted to high pressure steam. To M. Kopp is due the discovery of preparing, on the large scale, the pure colouring matter from madder, and, also, of getting purpurine separately therefrom; this substance is very little used, but the alizarine (the chief tinctorial matter contained in madder) is largely used. At Cosmarros, a town in Bohemia, and at Thann, France, the direct application of alizarine, without the use of mordants, has been most successfully applied, especially in the last-named town, by M. Scheurer. The author enters into some purely technical details on this subject, which, however interesting, we leave out, following him rather to the more purely chemical part of his paper. Madder contains:—(1). Alizarine, $C_{20}H_{12}O_6$, a solid substance, readily crystallising, forming orange-coloured needle-shaped crystals by sublimation by heat, soluble in benzol, also in warm alcohol, yielding, with alkalies, a bluish purple-coloured solution. (2). Purpurine, $C_{20}H_{12}O_7$, a solid substance exhibiting red-coloured, needle-shaped crystals, when crystallised from alcohol, or, also, by sublimation by heat; but by this latter process, a large portion of the substance is decomposed; soluble in benzol, also in warm alcohol, and yields with alkalies, red coloured solutions. (3). Pseudo-purpurine, $C_{20}H_{12}O_8$, a solid substance, exhibiting, when crystallised from its solution in benzol, small brick red-coloured needle-shaped crystals; is decomposed by heat, yielding purpurine; soluble in benzol, very slightly soluble in alcohol, even at boiling point, and yields, with alkalies, a red coloured solution. (4). An orange-coloured matter, $C_{20}H_{12}O_7 + 2H_2O$, a solid substance, exhibiting, when obtained by the slow evaporation of its alcoholic solution, a crystalline conglomerated mass; is decomposed by heat, yielding purpurine; insoluble in benzol, very soluble in alcohol, and does not yield a solution with alkalies. (5). Purpuro-xanthine, $C_{20}H_{12}O_8$ (?), a solid substance, yielding, either by sublimation, or by evaporation of its solutions in alcohol or benzol, yellow-coloured needle-shaped crystals; sublimes by heat; readily soluble in benzol, as well as in alcohol; and yields, with alkalies, a yellow-coloured solution. As regards the formulæ here quoted, the author desires it to be understood that they represent exactly the percentical composition, but that, in a scientific point of view, these formulæ do not express the constitution of the substances; moreover, C=12; H=1; and O=16 in this case. Each of these five substances is fit for use as a dyeing material; but alizarine alone is the dye *par excellence*. It appears, says the author, that the solidity (the fastness or goodness) of the different tints of colours produced by these dyes varies in the inverse ratio of the quantity of oxygen contained in the substance in excess of the hydrogen. Where the quantity of oxygen increases, we come from a more violet red to a bright red, and at last to brick red; and from bright violet colour to a more dirty violet, and, next, to greyish violet. Science has to elucidate practice in many points in respect of madder. No doubt a thorough study of this subject will enable us to find the key to the best mode of so mixing the different bodies to be described, as to produce pigments precisely suited to each peculiar shade of colour required.

Quantity of Copper Produced in the Year 1866 over the Whole World.—M. Petitgand.—The quantity of this metal raised on the entire globe, in the year alluded to, the latest period that statistical records of this kind have been reliably brought together, amounts to 93,415 tons, which is nearly double the quantity raised in 1846. From the statements made by this author, there appears to be an increasing tendency to a lower cost price of this metal. Large and valuable deposits of excellent copper ore known to exist, especially in Polynesia, are as yet untouched.

Moniteur Scientifique, No. 304, August 15, 1869.

This number contains the following original papers and communications:—

Limit of Magnetisation of Iron and Steel.—M. Waltenhofen.—The result of the author's researches on this subject are, that the magnetic moment of the unit of weight of iron may attain a certain limit which is constant and independent of the form and dimensions of the electro-magnet. The absolute value is about 2100 absolute units, expressed in milligrammes. The limit of magnetisation which soft iron can temporarily attain is about five times greater than the permanent magnetism obtained with steel bars, which rarely exceeds 400 units to the milligramme.

Mercury Mines of Almaden.—M. Jouglet.—From this lengthy paper, we learn that mercury, as metal, has been known from the most remote antiquity—that there have been mines worked for mercury ore in Asia Minor in the time of Xenophon; the mines of Almaden, Spain is yet the largest source of mercury for Europe. The cost of 100 kilos. of the ore is, everything included, only 16 francs and 10 centimes; but it yields, as this author says, by unsuitable management, only 6·9 per cent of mercury, 100 kilos. of which cost, on the spot, 141 francs and 30 centimes; but at Sevilla the price is already 177 francs and 80 centimes, in consequence of cost of transport and the iron vessels in which the metal is carried. The average quantity of mercury produced annually amounts to about 15½ tons, by weight.

Poisoning Caused by Green Tarlatan.—M. Bobierre.—The author says that he obtained from Nantes a sample of this kind of tissue, which, on being tested, was found to contain 10·3 grms. of Schweinfürt green (arsenite of copper) to the square metre, equivalent to 6·03 grms. of arsenious acid. The full dress made of this tissue contained, by weight, no less than 391·4 grms. of arsenite of copper, equivalent to 229 grms. of arsenious acid. At even every slight shaking of the tissue, clouds of a greenish dust came off, which readily explain the poisoning of the party who made the dress. The author tested—1st, by treating the tissue with an alkaline lye, passing chlorine through the solution and converting the arsenic acid into ammonio-arsenite of magnesia; 2nd, by estimating the quantity of black oxide of copper left after burning the tissue in a red-hot muffle.

Comptes Rendus des Séances de l'Académie des Sciences, August 30, 1869.

This number contains the following original papers bearing upon, or more or less relating to, chemistry and allied sciences:—

Antidote of Nicotine.—M. Armand.—The author proposes that the deleterious effects of the use of tobacco should be counteracted, if not entirely annihilated, by moistening tobacco, while undergoing the various preparations and fermentations, previous to its delivery to the consumer, with a strong infusion, or other preparation, of water-cresses, since the author has discovered that this vegetable contains principles which, without destroying the peculiar aroma of tobacco, destroy the deleterious effects of nicotine.

Action of Hydrate of Potassa upon the Sulphuretted Derivatives of the Carbides of Hydrogen.—M. Berthelot.—The author has studied the action of fusing caustic potassa upon the sulphuretted derivatives of some hydrocarbons which are not decomposed by water or alkalies at 100°. The soda-salt of hydrethylosulphuric acid, $C_4H_6S_2O_6$, is readily decomposed, and the result is the formation of pure ethylen and an alkaline sulphite—

$$C_4H_5NaS_2O_6+KHO_2=C_4H_4+H_2O_2+S_2KNaO_6.$$

Formenosulphate of soda, $C_2H_3NaS_2O_6$, should, by analogy, have yielded methylen, C_2H_2; but an excess of potassa decomposes the formenosulphate of soda, yielding hydrogen and carbonate and sulphite of alkalies—

$$C_2H_3NaS_2O_6+3KHO_2=C_2K_2O_6+S_2KNaO_6+3H.$$

With a relatively small quantity of potassa, a very volatile methylsulphide is formed, which, in many respects, is like methylic mercaptan. The author has extended his researches over a large number of equally complex compounds as those already alluded to; but, to be well understood, it would be required to quote a very large number of complicated formulæ; we therefore refrain from further abstraction of this paper.

Synthesis of Acetic Acid from Acetylen by a New Method.—M. Berthelot.—After referring to a now well-known method for the conversion of acetylen into acetic acid, devised by this author some time ago, the author now communicates another, and easier method—to wit, the heating of protochloride of acetylen, either with aqueous potassa solution up to 230° or heating with an alcoholic solution of potassa up to 100°, for about ten hours. When the perchloride of acetylen is heated with an alcoholic solution of potassa up to 100°, glycolic acid is formed; and when the same perchloride is heated with aqueous potassa up to 230°, oxalic acid is formed.

September 6, 1869.

This number opens with a report on the practice of—

Heating Wines in order to Improve and make the same Keep Better.—M. Pasteur.—The contents of this paper are only interesting to wine growers. It appears, however, that the cautious heating of wine (on the large scale, and before it has reached maturity) not only improves its quality, but has the effect of making it keep better, and render fit for transport on long journeys, and by sea, such brands of French wines as are otherwise not suitable, on account of their rapid deterioration.

Detailed Account of the Spectrum of the Sun's Spots.—Rev. Father A. Secchi, S.J.—This indefatigable *savant* gives in this paper a very precise and fully detailed description of this difficult subject, which, however, since it is treated in a strictly astronomical style, we do not further allude to.

Nature of Aniline Green.—MM. A. W. Hofmann and Ch. Girard.—The authors treat, in this memoir, the following subjects:—*What is iodine green?* is a question first answered by stating that it is a secondary product, which is formed during the manufacture of the colouring matters generated by the methylation and ethylation of rosaniline, and known in commerce as Hofmann's violets. The preparation of iodine green (more correctly, green produced by iodine) is next treated at length; the preparation of this substance in crystallised state is then fully described. The composition of this green is—

$$C_{22}H_{23}N_2OI_2=\left\{\begin{matrix}H_{16}\\C_{20}(CH_2)_3\end{matrix}\right\}N_2\left\{\begin{matrix}CH_2I\\CH_2I'\end{matrix}\right\}H_2O.$$

This memoir is a very lengthy and exhaustive monograph on this subject not well suited for further condensation.

Thermochemical Researches on the Substances formed by Double Decomposition.—MM. Berthelot and Longuinine.—This memoir, divided into several chapters, is too much filled with a very large number of figures, without which this paper cannot be well understood, and, therefore, we regret that we can only here quote the title of a highly scientific memoir wherein the authors have laid down the results of a long series of carefully-made experiments.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 200, August, 1869.

Leaving the papers relating to mechanics, steam engineering, and watchmaking, met with in this number, we notice the conclusion of a very lengthy, yet very excellent, monograph on—

Truffles.—M. Chatin.—The chemical composition of these cryptoganic vegetables has been investigated at even so early a period of the infancy of chemical analysis as the year 1803, and at various epochs after that year, such investigations have been especially conducted in France. The latest

researches on this subject have been recently made, and are quoted by the author, as well as the analysis made by M. Payen. From these we learn that the *Agaricus campestris*, the edible mushroom, contains, in 100 parts:—Water, 91·010; nitrogenous matter and traces of sulphur, 4·680; fatty matter, 0·396; cellulose, dextrin, sugar, and mannite, 3·456; saline matter, 0·458, among which there is a very large proportion of phosphoric acid. Genuine truffles contain 76·60 per cent. of water and 23·40 per cent. of solid matter, including 7·16 per cent. of nitrogen; upon 100 parts, the ash of truffles contains 27·40 phosphoric acid, and 28·34 potassa; the quantity of phosphoric acid contained in the ash of truffles growing in the neighbourhood of Nérac amounts to 33·5 per cent. This paper contains valuable information on the cultivation of truffles, on the bibliography of this subject, and on the commercial importance of a vegetable which, at first sight, one would hardly credit to yield, to fifty departments of France, a sum of nearly 16,000,000 francs yearly. The author states that these vegetables are highly nutritious, and that, when taken at meals in lieu of butcher's meat, they are readily enough digested, provided they are properly cooked, for which purpose the author gives the necessary directions.

Estimation of the Quantity of Non-Saponified Fatty Matter contained in Soap.—Dr. Bolley.—Dry the soap at 100°, in order to eliminate, as much as possible, any water it contains. Treat the soap, after having been previously reduced to thin shavings, or powder, if possible, with rectified benzol, or petroleum naphtha. Boil the soap for several hours with this fluid placed in a retort, and take care to pour back into that vessel any of the hydrocarbon which distils over. Next filter the liquid, and evaporate on a water-bath. 11·3 grms. of Marseilles soap (this is made with inferior kinds of olive oil and soda) treated in this manner left a residue, on evaporation, weighing 0·145 grm., or 1·2 per cent.; this quantity consisted of the non-saponified fatty matter, and a very small quantity of soap which had been dissolved. On igniting the residue just mentioned, it left 0·002 grm. of ash, equal to 0·13 per cent. of the soap submitted to analysis.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 6, 1869.

This number contains the following original papers relating to chemistry:—

Researches concerning the Isomerism of the Salicylic Series.—M. Henry.—The chief object of this lengthy memoir is the study of the action of pentabromide of phosphorus upon a number of salicylic compounds. Considering the existing analogy between pentachloride and pentabromide of phosphorus, the conclusion seemed justifiable that these two bodies would act in the same manner upon aldehyde and salicylic acid. The author's researches have proved that, instead of this supposition being correct, the pentabromide behaves as if it were free bromide, giving rise to the generation of bromated organic compounds only.

Researches concerning the Ethereal Derivatives of the Acids and Polyatomic Alcohols.—M. Henry.—The author gives a review of his experiments on the chloride of ethylglycollyl, obtained by the action of terchloride of phosphorus upon ethylglycollic acid. The author's aim was to apply that chloride, in order to produce several diglycollic combinations which would have been interesting for the elucidation of isomerism in general; this aim has not, however, been attained by the author at present.

Researches on the Derivatives of Phenyl-Acetic (α Toluic) Acid.—Dr. Radziszewski.—This memoir, like the two foregoing, of which the headings were mentioned, does not admit of suitable abstraction. This second portion of a monograph on this subject is divided into nine separate sections, and contains a complete and exhaustive review of a lengthy series of complex compounds derived from phenyl-acetic acid, $C_6H_5—CH_2—CO(OH)$.

The American Journal of Science and Arts, July, 1869.

This number contains the following original papers:—

Charles Grafton Page.—A biography of this deceased philosopher, who has been, for a series of years, one of the foremost scientific investigators of the Union.

Hortonolite, a New Member of the Chrysolite Group.—Messrs. Brush and Blake.—The mineral alluded to has a dark yellowish green colour on the fresh fracture, and a vitreous to resinous lustre; hardness, 6·5; sp. gr., 3·91. Before the blowpipe in the closed tube no change takes place; in the open tube, and on charcoal, the mineral becomes dull and magnetic, and fuses in the platinum forceps; with borax and salt of phosphorus it yields the reaction for iron and silicic acid, and with soda for manganese. The pulverised mineral forms, with hydrochloric acid, a gelatinous mass, and is almost completely decomposed. Average composition, in 100 parts:—Silica, 33·59; protoxide of iron, 44·37; protoxide of manganese, 4·35; magnesia, 16·68; lime, a trace; potash, 0·39; loss on ignition, 0·29. A spectroscopic examination of the concentrated chlorhydric solution showed sodium, potassium, and calcium lines only.

Effect of Atmospheric Air, when Mixed with Gas, in Reducing its Illuminating Power.—Messrs. B. Silliman and A. Wurtz.—The results arrived at by the authors may be summarised as follows:—For any quantity of air less than 5 per cent., mixed with gas, the loss in candle power due to the addition of each 1 per cent. is a little over 6-10ths of a candle (0·611 exactly); above that quantity, the ratio of loss falls to half-candle power for each additional 1 per cent. up to about 12 per cent. of air; above which, up to 25 per cent., the loss in illuminating power is nearly 4-10ths of a candle for each 1 per cent. of air added to the gas. With less than one-fourth of atmospheric air, not quite 15 per cent. of the total illuminating power remains, and with between 30 and 40 per cent. it totally disappears.

Formation of Sugar in the Liver.—Dr. Barker.—A physiologico-chemical essay.

Aurora at Toronto, Canada.—Mr. Kingston.

Qualitative Separation of Cobalt and Nickel.—Mr. F. W. Clarke.—As is well known, ferricyanide of potassium precipitates cobalt and nickel from their solutions. The cobalt precipitate is of a deep reddish brown colour, while the nickel compound is of a dirty yellowish brown. The nickel ferricyanide is readily soluble in ammonia and in solution of cyanide of potassium, while the corresponding cobalt compound is absolutely insoluble in either. It is a noteworthy fact that the previous presence of either ammonia or potassium-cyanide entirely prevents the precipitation of cobalt by the ferricyanide; the solution, when ammonia is present, merely assuming an intense blood-red colour. It is always best to employ ammonia to dissolve the nickel precipitate, since the presence of a cyanide renders the subsequent detection of that metal rather difficult. The author proceeds, as follows, in an analysis:—To the slightly acid solution containing the two metals, first an excess of chloride of ammonium is added; this causes the cobalt precipitate, which otherwise would run through the filter, to fall in a denser state, and also of much darker colour, often nearly black. The ferricyanide of potassium is then added, until the precipitation is complete, and afterwards strongly agitate with a considerable excess of ammonia. Upon filtering, all the cobalt remains upon the filter, being recognised by the characteristic colour of the precipitate, and the nickel is readily detected in the filtrate by means of ammonium-sulphide. This process is merely offered, the author states, as a convenient means of detecting cobalt and nickel in presence of each other in ordinary analyses.

Wollongongite, a remarkable Hydrocarbon found in the Wollongong District of the Illawarra Coal Field, N. S. Wales.—Mr. Silliman.—This remarkable substance occurs five miles inland, and forty miles south of Sydney, in cubical blocks, without lamination, extremely

tough, and resounding like hard wood under the blows of the hammer. Hardness, 2·5; sp. gr., 1·04 to 1·49; lustre, resinous; colour, greenish black and brownish black; tasteless; insoluble in alcohol, ether, or benzol; slightly soluble in sulphide of carbon; heated in a test-tube, it does not melt, decrepitates and distils a copious flow of oil of a yellow colour and heavy odour, giving off much gas; it is readily kindled, in thin splints, by a match, burning with a brilliant flame and much smoke. Analysis in platinum crucible yields:—Volatile matter, 82 5 per cent.; fixed carbon, 6 5 per cent.; ash, 11·00 per cent.

Estimation of Carbonic Acid.—Mr. S. W. Johnson.—Since the woodcut added to this paper is abolutely required for it to be clearly understood, we do not abstract it here.

Journal für Gasbeleuchtung, July, 1869.

We notice from this number the following papers and communications of more general interest:—

Effect of Illuminating Gas upon Vegetation.—Dr. Poselger.—The author of this paper deserves the thanks of a great public for his energy in determining, by positive experiments, that the death of fine trees growing along the streets and promenades of many, especially continental, towns, is not due, as has been too often asserted, to the effects of leakage in gas mains. From the author's experiments, made with trees and shrubs, it is a settled point that no damage can accrue to the trees, nor their growth interfered with, by any quantity of gas which may escape in the soil and find its way to their roots. Moreover, the author points out that no care is taken at all with the trees, as regards keeping the soil covering the roots, so as to admit of air permeating freely; that too often that soil becomes as hard as rock; and that, in very many cases, the filthy habit of using trees, especially if so thick as to admit of a man hiding behind it, instead of urinals, contributes largely to the destruction of fine old trees. The leakage of gas, or the laying down of mains near the roots, has nothing to do with this destruction; other causes influence the decay of trees, but with these we do not further occupy ourselves.

Brief Abstracts from the Reports of the Meeting of German Gas Engineers and Gas-Works' Managers held at Coburg at the end of May.—*Analysis of Oberurseler Oxide of Iron.*—This material is applied for the purification of gas, and was found to consist principally of 36 5 per cent. of a siliceous sand, 38 per cent. of Fe_2O_3, and 11·7 per cent. of Mn_2O_3. The material known as Mannheim oxide of iron contains 98 per cent. of Fe_2O_3, and small quantities of lime and sand. *Report of the Committee on Photometry.*—This paper contains a description of a series of experiments made at Frankfort-on-the-Maine, with the view to enable the gas-works' managers throughout Germany and some adjoining countries to adopt a general plan of making photometrical tests of the gas they manufacture. From this report, we learn that the use of glycerine, instead of water, in wet gas-meters is attended with some danger, owing to the fact that, after a length of time, the glycerine appears to attack the metal working parts of the meter, and give rise to leakage. The quantity of gas consumed last year in Paris amounts to 138,797,811 cubic metres; this figure has to be multiplied by 35·3165 to convert it into English cubic feet.

Les Mondes, August 19, 1869.

This number contains:—

The Electrical Machine of Holtz.—Dr. P. J. Kaiser, the celebrated astronomer and physicist, of Leyden University, and his equally eminent colleague, Professor Ryke, have been not only experimenting with this instrument, but have very much improved its construction, and thereby largely increased its efficacy. We regret that we cannot enter into details on this subject, owing to the fact that, for the proper understanding the woodcut annexed to the original would have to be reproduced.

Theoretical and Practical Studies on the Divers Processes in Use for the Purification (Defecation) of Beet-Root Saccharine Juice by means of Lime and Carbonic Acid.—M. Feltz.—This paper treats, at length, on a subject of considerable importance to the parties more immediately interested, beet-root sugar manufacturers. There is added to it a very precise description of the different methods of estimating the quantity of lime contained in the clarified juice, and, also, divers processes for the quantitative estimation of the organic matters, other than sugar, contained in the said juice. The paper is too long, however, for useful abstraction, and is to be continued in following numbers of this periodical.

We learn from this number that two scientific men of great name in their time have died at an advanced period of life—Prof. Purkinge, of Prague, died on the 24th of July last, aged eighty-two years; Dr. Carus, of Dresden, born in 1789, died also a few weeks ago.

August 26, 1869.

This number contains the following original article:—

Theoretical Chemistry.—M. Maumené.—The author's chief object is to prove that chemists should avail themselves of the author's "Théorie Générale de l'Action Chimique;" and, in order to exhibit it, the author refers to M. Schutzenberger's recent discovery of hydrosulphurous acid. Hydrosulphite of soda, NaO, S_2O_3H, when exposed to heat, after having been carefully dried, yields a little water, sulphur, and sulphurous acid, and leaves a residue consisting of sulphate and sulphuret of sodium. The author of this paper puts the question, Why hydrosulphite of soda should give, under the influence of heat, all the products just enumerated? Why should we not have a more simple action? as, for instance—

$$NaO.S_2O_3H = NaO.SO_3 + HS,$$

or—

$$= NaO.SO_3 + HO + S.$$

Every impartial chemist will at once admit that not one of the hypotheses at present current in the science of chemistry can serve to explain this. My theory exhibits precisely why these more simple actions cannot take place, and why all the bodies observed to be formed by M. Schutzenberger, must of necessity be formed. When a salt is submitted to the action of heat, the acid and base of that salt only constitute, during the action of the heat, a simple mixture acting by equal weight. For one equivalent, E, of one of these two bodies (that is to say, that which has the highest equivalent), the number, *n*, of the equivalents, E', of the other body (that the equivalent of which is the lowest) is expressed by the general formula—

$$n = \frac{E}{E'}$$

We have, therefore, in the present instance—

$$n = \frac{57(S_2O_3H)}{31(NaO)} = 1{\cdot}84$$

that is to say, that the equivalent of the acid S_2O_3H, at the moment that the heat becomes strong enough to cause its dissociation from the soda, acts upon 1·84, say, nearly two equivalents of soda. We have, therefore—

$$2NaO + S_2O_3H = NaO.SO_3 + NaS + HO,$$

This first action is followed by a second; one-half of the acid was free; it has, by itself, been exposed to the action of the heat, and gave—

$$S_2O_3H = SO_2 + S + HO.$$

The total result of the decomposition is, therefore, the sum of the equals—

$$2NaO.S_2O_3H = NaO.SO_3 + NaS + SO_2 + S + 2HO.$$

as observed by M. Schutzenberger.

Cosmos, August 21, 1869.

This periodical contains, among other interesting matter:—

Description of the Self-Registering Instruments used at the Kew Meteorological Observatory.—Messrs. R. and J. Beck.—The editor of this paper states that, since these well-known eminent instrument-makers are amongst his subscribers, he has been favoured with the excellent woodcuts and description given by the makers of the instruments.

Discovery of Coal.—On the eastern shores of the Caspian Sea, abundant seams of coal have been found. The steam-ships navigating on that sea have hitherto used wood as fuel, which had to be carried far away from the Ural mountains at great cost. The coal is of very good quality. More than forty years ago, the late A. von Humboldt stated his belief that coal would be found in this region at no great depth under the surface of the ground, since this entire locality abounds in naphtha.

Pharmaceutische Zeitschrift für Russland, May, June, and July, 1869.

These three numbers of this periodical have been published simultaneously, and are, therefore, taken together. The leading article, commenced in the May number, and continued through the two others, is a lengthy monograph on the following subject:—

Best Method of Preparation and Constitution of Hyoscyamine, and the relation this Alkaloid bears to the Quantity of Nitre (Nitrate of Potassa) contained in the Plant wherein the Alkaloid occurs.—M. Thorey.—The author divides this paper into three sections, respectively headed—On the preparation of hyoscyamine; the constitution of that substance; and its relation to the quantity of nitre the plant which yields it contains. The preparation of this alkaloid is described by the author with full details, as given by the very large number of chemists and pharmaceutists who have worked on this subject. Among the various methods of preparation of this alkaloid devised by the author, we notice the following:—50 grms. of *Semina hyoscyami nigri* (common henbane) are ground to powder, exhausted with 150 grms. of alcohol (85 per cent. strength), and the alcoholic tincture concentrated by distillation, one-half of the bulk of the alcohol being distilled off. The residue left in the retort is next mixed with water, filtered, reduced, by evaporation, to about 30 grms., and then again filtered. The filtrate is mixed with a solution of caustic potassa, after having been previously heated to 40°, next treated with chloroform, the chloroformic solution washed with water, until that fluid runs off quite clear, and the solution thus obtained evaporated to dryness, leaving 0·0835 grm. of a yellowish mass smelling like tobacco. This mass is re-dissolved in weak hydrochloric acid, filtered, carefully saturated with caustic potassa, again treated with chloroform, this solution again washed with water, and, at last, left to spontaneous evaporation over sulphuric acid, yields well-crystallized hyoscyamine. The alkaloid thus obtained is a quite pure, colorless substance, of bitter taste, readily soluble in dilute alcohol, in ether and chloroform, in benzine and amylic alcohol, and dilute acids. Among its characteristic chemical reactions, belongs a red amorphous precipitate, with the double iodide of bismuth and potassium; a yellow precipitate, gradually verging on blue, when left standing with phospho-molybdate of soda; a flocculent yellow precipitate with chloride of gold, which, after a time, becomes crystalline; a deep kermes red coloration with aqueous solution of iodine; and an amorphous yellowish gray precipitate with tannic acid. During his researches on this subject, the author has discovered that henbane contains, in addition to hyoscyamine and saltpetre, a peculiar resinous substance, and an acid. The resinous material is remarkable, since it contains nitrogen, its percentical composition being—C, 67·67; H, 8·772; N, 3·508; O, 20·05. As regards the constitution of hyoscyamine, the author says it is, at present, not easily possible to control the statement made by M. Kletzinsky, that this alkaliod should be the nitrile of santonate of ammonia. The question, What relation the hyoscyamine bears to the quantity of saltpetre contained in the plant which yields it? is treated at great length; but it is difficult to give any brief *résumé* of these researches, which are recorded in several tabulated forms full of figures. All parts of the henbane contain a considerable quantity of nitrate of potassa; and it appears that, while that quantity varies at various periods of the growth of the plant, so, also, varies the quantity of hyoscyamine contained in the various parts of the plant. The quantity of hyoscyamine contained in the leaves of the plant dried at 110°, and taken before the blooming period, varies from 0·023 to 0·208 per cent. The seeds contain from 0·048 to 0·160 per cent. of hyoscyamine.

Comparative Study on the Characteristics of the Halogens and their Combinations, and especially, also, on Hyperiodic Acid.—Dr. Ferrein—This monograph contains the history of the halogens (chlorine, bromine, iodine, flourine), treated at length, from the earliest days of Lavoisier and Scheele up to the present time. The essay is too lengthy for any useful abstraction.

PATENTS

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1683. H. Holdrege, New York, U.S.A., "Improvements in the process of making gas for illuminating, heating, and other purposes, and in apparatus for the manufacture thereof."—Partly a communication from W. H. Gwynne, New York, and G. W. Harris, Elizabeth, New Jersey, U.S.A.—Petition recorded May 31, 1869.

2039. W. Pidding, Lambeth, Surrey, "Improvements in the mode or modes of obtaining scents, aroma, perfume, or essential oils, from flowers and from all vegetable substances producing the same; also in the machinery or apparatus in connection therewith."—July 6, 1869.

2328. J. T. Way, Kensington, Middlesex, "Improvements in the manufacture of soap, and in cleansing wool and woollen goods."—August 3, 1869.

2345. E. Beanes, Cordwalles, near Maidenhead, Berks, "Improvements in preserving articles of food."—August 5, 1869.

2413. D. Barker, Northfleet, Kent, "Improvements in the manufacture of artificial fuel."—August 12, 1869.

2418. D. A. Gibbs, Milton Street, London, "Improvements in compositions for coating or covering the sides and bottoms of ships and vessels."—August 13, 1869.

2431. W. Matt, Homerton, Middlesex, "An improved compound, or composition, in imitation of marble, veneer, and other substances, to be used in the manufacture of fancy and other articles."—August 14, 1869.

2440. H. Pinkus, Camden Town, Middlesex, "Improvements in furnaces and other heating apparatus, and in the methods of applying and using therewith certain elements of combustion, and in the combinations therewith of the processes, with materials to be used in the manufactures of metals, and other things and uses, and in the mechanical constructions necessary therefor."

2443. J. G. Dale and E. Milner, Warrington, Lancashire, "An improved method of producing white pigments from lead."—August 16, 1869.

2482. F. Braby, Euston Road, Middlesex, "Improvements in the means and apparatus for the manufacture of caustic ammonia and ammoniacal salts."—August 19, 1869.

2490. W. Byrne, Belfast, Ireland, "Improvements in the process of distilling alcoholic liquors, and in apparatus for that purpose."

2493. A. V. Newton, Chancery Lane, "An improvement in the process of manufacturing paint."—A communication from S. R. Bradley, New York, U.S.A.—August 20, 1869

2500. P. A. Blake, Highbury, Middlesex, "A new or improved safety explosive compound or compounds to be used for blasting and other purposes, together with means connected with its use."—August 21, 1869.

2503. T. Gibb and C. Gelstharp, Jarrow-on-Tyne, Durham, "Improvements in the extraction of copper from its ores."—August 23, 1869

NOTICES TO PROCEED.

1224. M. Henry, Fleet Street, London, "An improved mode of obtaining pyrophosphate of lime."—A communication from E. Deligny Boulevard St. Martin, Paris.—Petition recorded April 21, 1869.

1290. S. Oakman, Boston, Suffolk, Mass., U.S.A., "Improvements in the construction of smelting and other furnaces."—April 26, 1869.

1380. W. Mackean, Paisley, N.B., "Improvements in the manufacture of cattle food."—May 5, 1869.

1486. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of beet-root and other pulps, and in machinery or apparatus employed therein."—A communication from H. Champonnois, Paris.—May 14, 1869.

under pressure (a pressure equivalent to 230° C. being required), the solution evaporated with carbonate of soda and ignited; or the iodides and bromides separated by dialysis from the organic matter, and proceeded with in the same manner as described for waters.

The separation of the large excess of the chlorides from the iodides can also be effected by nitrate of silver; for in precipitating a solution of 100 gr. of chloride of sodium, to which were added 0·2989 gr. of iodide of potassium, with nitrate of silver, until the precipitate came down white, and digesting it for some time with the fluid, it could be filtered off without the filtrate containing any iodine, by which it seems as though the iodide of silver, which otherwise would be dissolved in an excess of chloride of sodium, is replaced by chloride of silver.

This precipitate was then decomposed by Hydro-sulphuric acid, the excess of this acid destroyed by sesquisulphate of iron, and the iodine precipitated with chloride of palladium.

It gave 0·0942 gr. metallic palladium, equivalent to 0·2950 gr. or 98·71 per cent. of the iodide of potassium taken. This method does not, however, offer any peculiar advantages over the old one.

I give below a number of figures which may perhaps be useful with regard to the treatment of precipitates obtained in analyzing substances containing iodine and bromine, and which may, perhaps, suggest some new ideas.

(1.) 0·6061 gr. K I were dissolved in water acidulated with nitric acid, and precipitated with an excess of nitrate of silver.

The precipitate was, after drying and igniting, heated to fusion with the usual precautions; it yielded 0·8570 gr. Ag I=0·6058 gr. K I=99·95 p. c. of the quantity taken.

(2.) 0·5180 gr. K I were treated in the same way, the precipitate filtered on a weighed filter; it yielded by drying it:

For 60 hours over HO,SO_3=1·1149 gr. Ag I=0·5222 gr. K I=100·81 p. c.
For 84 hours over HO,SO_3=1·1092 gr. Ag I=0·5182 gr. K I=100.01 p. c.
For 5 hours at 170° F.=1·1057 gr. Ag I=0·5156 gr. K I=99·53 p. c.
(Weight of filter=0·3761 gr.)
After igniting and fusing=0·7324 gr. Ag I=0·5177 gr. K I=99 94 p. c.

By long-continued drying the filter will have a reducing action on the iodide.

(3.) 0·5929 gr. K I were mixed with 1 gr. Na Cl and precipitated with a solution of Ag Cl in NH_4O; after standing for twenty hours the precipitate was filtered out, washed, and dried:

For 60 hours over HO,SO_3=0·8429 gr. Ag I=0·5961 gr. K I=100·54 p. c.
For 84 hours over HO,SO_3=0·8359 gr. Ag I=0·5911 gr. K I=99·69 p. c.
For 5 hours at 170° F.=0·8304 gr. Ag I=0·5869 gr. K I=98·99 p. c.
After igniting &c.=0·8342 gr. Ag I=0·5896 gr. K I =99·45 p. c.

The precipitate, if dried, must therefore only be dried over HO,SO_3.

(4.) 0·7240 gr. K Br, treated as under No. 1, gave, after ignition:

1·1337 gr. Ag Br=0·7177 K Br=99·13 p. c.

The bromide of potassium was not tested as to its purity.

(5.) 0·1803 gr. K I were dissolved in water slightly acidulated with nitric acid, PdO,NO_5 added, warmed, and, after 24 hours' standing, filtered on a weighed filter, it gave:

After 3 hours' drying at 180° F.=0·2071 gr. Pd I
" 4 " " " " =0·1964 gr. "
" 5 " " " " =0·1964 gr. "
=0·1809 gr. K I=100·33 p. c.
After ignition in air=0·0589 gr. Pd=0·1836 gr. K I =101.83 p. c.

(6.) 0·3250 gr. K I treated in the same way gave:

After 60 hours' drying over HO,SO_3=0·3539 gr. Pd I =0·3266 K I=100·33 p. c.
After 84 hours' drying over HO,SO_3=0·3522 gr. Pd I =0·3245 K I=99·84 p. c.
After 5 hours' drying at 180° F.=99.07 p. c.
After ignition in air=101·79 p. c.
" " under hydrogen=100·02 p. c.

(7.) 0·2072 K Br, treated in the same way, gave,

After drying at 170° F. for 4½ hours:
=0·1954 gr. Pd Br=0·1746 K Br=84·21 p. c.
After igniting in air
=0·0827 gr. Pd=0·1849 K Br=89·23 p. c.

It is therefore necessary to precipitate iodine, from solutions containing bromine, with chloride of palladium, and either to dry or ignite the residue under hydrogen.

I give here also the determination of potassa in iodide of potassium, according to the method described in H. Rose's Lehrbuch:

60 hours' drying over HO,SO_3=0·6699 gr. $PtCl_2$, K Cl =0·4546 K I=99·82 p. c.
84 hours' drying over HO,SO_3=0·6623 gr. $PtCl_2$, K Cl =0·4491 K I=98·62 p. c.
5 hours' drying at 170° F.=0·6556 gr. Pt Cl_3, K Cl= 0·4446 K I=97·93 p. c.
after igniting=99·88 p. c.

Paul Schweitzer, Ph.D.
School of Mines, Columbia College.

Colors from Petroleum Residues—a Swindle.

We were lately requested to give an opinion with regard to some samples of colors which a chemist (?) pretends to have made from petroleum residues, and in which he is seeking to interest capitalists. The specimens were very beautiful, but they resembled very closely the bronze powders which are extensively imported from Germany. We at once tested them for metals, and found that the brilliant red consisted of finely divided copper, the golden specimens of brass, and the silver white specimen chiefly of tin. The colors are simply metallic powders, and cannot, of course, have been extracted from petroleum residues. This is a gross imposition, which any chemist would at once detect.

Dangerous Kerosene.

The Board of Health continues to publish the addresses of dealers who sell dangerous kerosene, and suits were long ago commenced against a large number of them. But, thanks to the very tardy administration of justice in this city, the cases have dragged along for several months without coming to a trial. There is, however, a prospect that something will be done, and, as we go to press, we learn that the trial will certainly come off on Tuesday, October 18, *unless it is postponed.*

In the meantime, while some one is neglecting his duty, the kerosene murders continue. The newspapers

have recorded a considerable number of serious accidents since our last issue, some resulting in loss of property, others in the death—in some cases slow and protracted—of the unfortunate victims. "Liquid safety gas" and adulterated kerosene are still freely sold, with no fear of punishment; but let those death-dealing tradesmen consider that though they may escape immediate punishment for their cruel disregard of human life, the few cents per gallon, which they now make, is a very poor inducement for the crime against humanity, which they are daily committing.

Recent Chemical Patents.

Issued September 21, 1869,

94,942.—Apparatus for Evaporating Cane-Juice. M. S. Bringier, Ascension Parish, La.

94,959.—Apparatus for Evaporating Cane-Juice. L. S. Hereford, West Baton Rouge Parish, La.

94,969.—Method of Purifying Nitric Acid. G. M. Mowbray, Titusville, Pa.

94,994.—Manufacture of Iron and Steel. H. Bessemer, London, England.

94,995.—Manufacture of Iron and Steel. H. Bessemer, London, England.

94,996.—Manufacture of Iron and Steel. H. Bessemer, London, England.

94,997.—Manufacture of Iron and Steel. H. Bessemer, London, England.

95,017.—Manufacture of Galvanized Iron. J. D. Grey, Pittsburg, Pa.

95,036.—Composition for Use in Fire Extinguishers. J. M. Muterse and H. G. De Valory, Guérande, France.

95,039.—Extract of Madder for Dyeing and Printing. A. Paraf, New York.

95,040.—Process for Printing Colors on Textile Fabrics. A. Paraf, New York,

95,053.—Nickel-Faced Type. L. L. Smith, Brooklyn, N. Y.

95,075.—Manufacture of White Lead. S. R. Bradley, New York.

95,097.—Manufacture of White Lead. C. W. Dwelle, St. Louis, Mo.

Issued September 28, 1869.

95,201—Manufacture of White Lead. James Cuddy, Pittsburg, Pa.

95,295.—Process of obtaining Wrought Iron directly from the Ore. J. D. Whelpley and J. J. Storer, Boston, Mass.

95,307.—Process for Utilizing the Sulphur Fumes from Copper Ore. A. Bigelow, Newark, N. J.

95,342.—Soap or Detergent Compound. E. R. Breed, Farmington, Ill.

95,317.—Extract of Hops. H. Burgess, Royers Ford, Pa.

95,358.—Manufacture of Cast-Steel. L. La Breche-Viger, Montreal, Canada.

95,365.—Bleaching Paper-Stock. G. E. Marshall, Laurel, Ind.

95,377.—Medicated Soap. W. P. Pugh, High Point, N. C.

95,403.—Paint-Compound. J. Gould, Lexington, Mass.

Issued October 5, 1869.

95,405.—Composition for Making Types for Printing Wall-Paper, Oil-Cloth, and other Fabrics. R. A. Adams, New York.

95,412.—Apparatus for Carburetting Air and Gas. A. Barbarin, New Orleans, La.

95,419.—Purifying Iron and Steel, or other Metal. E. Brady, Philadelphia, Pa.

95,445.—Apparatus for Evaporating and Decomposing Liquids. A. Eckstein, Vienna, Austria.

95,459.—Manufacture of Coal-Gas. W. Gibson, Cambridge, Mass.

95,465.—Process of Preparing Alizarine. C. Graeb, Frankfort-on-the-Main, and C. Liebermann, Berlin, Prussia.

95,473.—Process of Seasoning Wood. T. W. Heinemann, New York.

95,474.—Process and Apparatus for Preserving Wood. T. W. Heinemann, New York.

95,484.—Manufacture of White Oxide of Zinc. R. Jones, Mount Holly, N. J.

95,494.—Marine Paint. W. H. Lewis, Boston, Mass.

95,496.—Manufacture and Refining of Sugar. L. J. F. Margueritte, Paris, France.

95,534.—Manufacture of Pigments for Paints. R. S. Stenton, New York.

95,568.—Manufacture of Iron and Steel. N. Cutter, Cincinnati, Ohio, and E. Savage, West Meriden, Conn.

95,574.—Process of Distilling Spirits. J. Ellingwood, Owensborough, Ky.

95,583.—Process of Treating Wood, to Preserve, Season, and give it a better Surface. J. Hayford and J. F. Paul, Boston, Mass.

95,624.—Mode of Applying Inks of Different Characters, so as to Print Safely, Revenue, and other Stamps. W. Thorpe, St. Louis, Mo.

95,626.—Ink for Printing Revenue, Postage, and other Stamps, so as to secure greater safety and prevent frauds. T. Antisell, Washington, D. C.

Issued October 12, 1869.

95,665.—Manufacture and Application of Gas from Petroleum, &c. T. H. Dickerson, Chicago, Ill.

95,668.—Evaporating Salt Water, &c. W. J. Dodge, Syracuse, N. Y.

95,679.—Soap. H. L. Guldin, Robeson Township, Pa.

95,686.—Apparatus for Heating Puddling Furnaces. S. A. Hill and C. F. Thumm, Oil City, Pa.

95,687.—Device for Generating Steam in Steam-Generators. S. A. Hill and C. F. Thumm, Oil City, Pa.

95,688.—Apparatus for Generating Steam in Boilers. S. A. Hill and C. F. Thumm, Oil City, Pa.

95,696.—Fire-Proof Paint. E. Kunzendorf, New York.

95,740.—Distilling Apparatus for Spirits. F. Sonier, Springfield, Ill.

95,752.—Manufacture of Crystal Glass. Otto Wuth, Pittsburg, Pa.

95,798.—Apparatus for Drying Sugar. A. Herbst, Moscow, Russia.

95,843.—Manufacture of Iron and Steel. C. W. Siemens, Westminster, England.

Reissues.

83,182, reissue 3,647.—Printing Certain Textile Fabrics and Yarns. American Print Works, Fall River, Mass.

92,934, reissue 3,667.—Method of Preserving the Aromatic Principle of Hops. E. D. Brainard, Albany, N. Y.

94,073, reissue 3,668.—Manufacture of Soap. W. T. Bush, Union City, Tenn.

NEW PUBLICATIONS.

Cyclopædic Science Simplified. By J. H. Pepper. London: Frederick Warne & Co. New York: Scribner, Welford & Co.

Probably no man in England has accomplished so much in the way of popularizing science as Mr. Pepper, Professor of Chemistry and Honorary Director of the Royal Polytechnic Institution of London. With a sound education, good natural ability, and a liberal supply of money, combined with that tact in presenting his subject to his audience, so necessary for success in this field of education, Prof. Pepper has established a wide popularity as a scientific lecturer.

In presenting the truths of science to a general audience, good judgment is necessary to present the salient points of the subject with striking illustrations, which will impress the facts permanently upon the minds of the hearer, abstaining from any lengthy discussion of abstruse and, save to the scholar, uninteresting phenomena and their causes; avoiding both the Scylla and Charybdis of many lecturers, the superficiality of that numerous class of charlatans who style themselves popular lecturers, on the one hand, and the tedious prolixity and particularity of many of the learned scientists, on the other hand.

This middle course Prof. Pepper has closely pursued, and thus deservedly ranks foremost among popular educators.

In the work now published he has adopted the same course as in his lectures, and has placed before the public a treatise of great value. The major part of the book is devoted to physics, the principles and theories of which are clearly and concisely stated, with full experimental illustrations. The latter portion of the book is devoted to chemistry, the properties and chemical reactions of the elements being briefly, but clearly, described. The more recent chemical and physical discoveries and applications are fully explained.

As a compilation of scientific information for popular reference, we do not think the work is excelled.

The book is handsomely printed upon tinted paper, and fully illustrated by several hundred woodcuts, the execution of which reflects great credit upon the publishers.

The Polytechnic. A semi-monthly paper devoted to the interests of polytechnic and scientific schools. Troy, N. Y.

We have received the first number of this journal, a handsomely printed quarto of twelve pages, edited by Mr. Montague L. Marks.

The subject matter of this first number is excellent, and we are happy to chronicle its establishment as the mouthpiece of the Rensselaer Polytechnic Institute, by far the leading school of civil-engineering in this country.

Paris Universal Exposition, 1867. Reports of the United States Commissioners.

The Progress and Condition of Several Departments of Industrial Chemistry. By J. Lawrence Smith, United States Commissioner.

In a pamphlet of 146 pages, Prof. Smith reports the progress of several branches of industrial chemistry, including the manufacture of sulphuric acid, soda and salts of soda, potash and its compounds, ammonia, baryta, magnesia and alumina, chlorine, fluorine, manganese, and carbonic acid; the industrial productions of oxygen, hydrogen, and other elements; the manufacture of illuminating gas from coal, and the utilization of the waste products, and the stearic acid industry. In a future number, a detailed review of this important contribution to the history of technical chemistry will be presented.

The American Journal of Science and Arts for September contains the following articles specially interesting to chemists: 1. On Durangite, a fluoarsenate from Durango in Mexico. By G. J. Brush. 2. Remarks on the Galvanic Battery. By G. W. Hough. 3. On Nitric Acid and Chlorate of Potassium as an Oxydizing Mixture Applicable to Sulphur, Sulphids, Chromium, Arsenic, Organic Matters, etc. By F. H. Storer. 4. On the Action of Light on Uranium. By H. C. Bolton. 5. On the Action of the Alkaline Nitrites upon Uric Acid and its Derivatives. By Wolcott Gibbs. 6. On the Meteoric Stone which fell Dec. 5th, 1868, in Franklin Co., Alabama. By G. J. Brush. 7. On the Lesleyite of Chester Co., Penn., and its Relations to the Ephesite of the Emery Formation near Ephesus, Asia Minor. By J. Lawrence Smith.

BREVITIES.

Lyceum of Natural History.—At the meeting of the chemical section of this society, October 11th, President Newberry in the chair, the following papers were presented and read: "A Memoir of the late Prof. Graham," by Prof. Joy, which was, however, owing to the absence of published material, not so much a memoir of the life of this savant, as an account of his works. Prof. Joy enumerated the titles of the principal papers of Graham, amounting to thirty, and mentioned his four important discoveries. Dr. Paul Schweitzer read a paper "On the Quantitative Separation and Determination of Iodine, Bromine, and Chlorine," which is printed in full in another portion of this journal. Prof. Charles A. Seely then spoke "On Dissociation," calling the attention of the Society to the want of literature on the subject, and giving his explanation of the phenomena of dissociation. Prof. Joy and Mr. Walz joined in the discussion. Mr. O. Loew, after reading a paper "On the Action of Sunlight on Iodide of Potassium," exhibited some closed glass tubes, containing a solution of this salt, which had assumed a yellow color, owing to the oxygen contained in the tubes. He also exhibited a tube filled with bisulphide of carbon, which by the action of sunlight had been converted into a black solid mass of sesquisulphide of carbon.

The American Institute Fair.—The Thirty-eighth Exhibition of the American Institute was opened September 5th, the opening address being delivered by Mr. Horace Greeley. The exhibition of American woollen manufactures is especially fine, the array of carpets of all grades, bunting, cloths, and dress goods being very extensive and brilliant. This is the most conspicuous portion of the exhibition, and specially gratifying to our national pride. It was hoped that all the accessory branches of industry would be well represented; but this hope has not been realized: the exhibition of woollen machinery is not as good as it should be, and raw materials, as well as printers' and dyers' chemicals and dyestuffs, are almost wholly unrepresented. This is greatly to be regretted, and not at all to the credit of the enterprise of the manufacturing chemists of this country. The department of chemistry and mineralogy is very insignificant. Messrs. Feuchtwanger exhibit specimens of the soluble alkaline silicates, and a few minerals. Messrs. F. W. Devoe's collection of colors and oils is very fine, and the best effort in the department. The exhibition of oils, etc., by Charles Pratt, is excellent, the specimens being numerous and handsome. Patterson & Brazeau exhibit artificial mineral waters, as well as the dry salts for making Kissengen, Vichy, and Congress waters. These salts will prove desirable for transportation to distant markets. Enoch Morgan's Sons have a good collection of soaps, and a fine crystallization of sal-soda; and Colgate & Co., and B. T. Babbitt, add to this portion of this department. A number of handsome specimens of graphite from Joseph Dixon & Co., some fine specimens of steel from the New York Steel Works, soluble Prussian blues, "Dry Extract of Annatto," "The Texan Liebig's Extract of Meat," "The Phœnix Disinfectant," an assortment of whiskies, rectified by distillation in vacuo, and Horsford's and Lauer's phosphoric acid bread powders, complete the catalogue of this department.

In other departments are many articles of interest to chemists. Among these we notice Gardner's method of lighting gas by the ignition of a platinum wire placed over the burner; Captain Kennedy's electric clock, curious, though it cannot be accurate for astronomical work, under all electric conditions of the atmosphere; a case of nickel-plated goods, not as handsome as silver, but less easily tarnished; a good collection of thermometers, hydrometers, and hygrometers from the leading manufacturers of New York; and a fine display of photographs, etc., from the best establishments. Altogether, the exhibition is exceedingly interesting, but not as complete, in many departments, as we supposed it would be.

Prof. Silliman has been appointed State Chemist of Connecticut by Governor Jewell.

Prof. A. K. Eaton will occupy the chair of Chemistry in the Eclectic Medical College of the City of New York.

Samuel Jones, A.M., has been elected Professor of Natural Philosophy and Chemistry in Washington and Jefferson College, Washington, Penn.

Prof. Henry Morton, of Philadelphia, the editor of the Journal of the Franklin Institute, has been elected Professor of Mechanics in the University of Pennsylvania.

Mr. George Peabody has made a further donation of $400,000 to the Peabody Institute of Baltimore.

Professors Lyman and Newton, of Yale College, have returned from Europe, with important additions to the collections of physical and mechanical apparatus.

In the University of South Carolina, Dr. A. G. Mackey has been elected Professor of Natural and Mechanical Philosophy, Dr. Joseph Jones Professor of Chemistry, and Mr. T. E. Hart Professor of Mathematics, to supply the vacancies occasioned by the resignations of Professors John Le Conte, Joseph Leconte, and E. P. Alexander.

The Project of a Grand International Exhibition, in Washington, in 1871, is being discussed. At a recent trade-congress in the West, the same subject was proposed, and the claims of the Mississippi Valley urged for the location of the fair in one of its cities.

The Estimated Income of the Smithsonian Institution, for 1869, is $53,100, an excess of $8,567 over the estimated expenditures.

The Estimated Expenses of the British Museum for 1869–70 are estimated at 113,203*l.*, which is 13,823*l.* more than the expenditures of last year.

The Thayer School of Civil Engineering, connected with Dartmouth College, has a total endowment of $60,000.

The Halsted Observatory, of Princeton, is nearly completed. The telescope, which is being constructed by Abram Clark & Sons, of Cambridgeport, Mass., will have an object-glass 25 inches in diameter, and a focal length of 30 feet. The total cost of the observatory will be not far from $200,000, which is being defrayed by Gen. Halsted, of Newark, N. J.

THE CHEMICAL NEWS.
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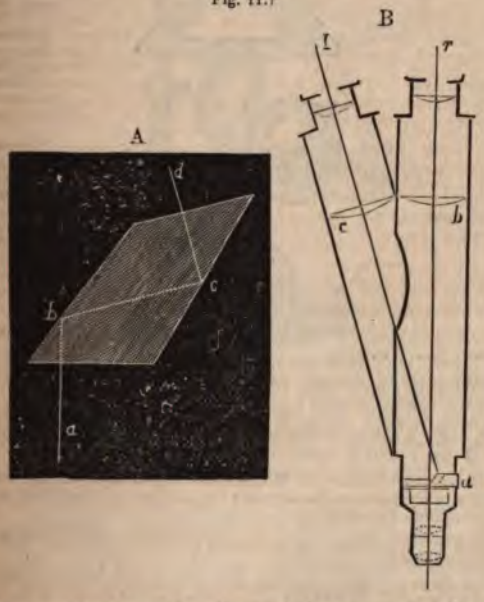
ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Am. Repr., Nov., 1869, page 285.)

A DESCRIPTION of the compound achromatic microscope can, at the present time, hardly be considered complete without some mention of binocular instruments. The binocular principle had been applied to opera glasses with great success for many years. More recently the invention of the stereoscope and its great popularity drew increased attention to the subject of binocular vision, but until a few years ago no attempt seems to have been made to adapt the principle to microscopes. Owing to the short focal length of microscopical objectives, the use of two convergent instruments would of course be impracticable; the only resource was to divide the pencil proceeding from the object-glass and convey half to each eye. The earlier attempts resulted

Fig. 11.†



in the production of pseudoscopic instruments; that is, the relative positions of the object viewed were reversed projections, being represented by depressions and the contrary. This was found to be caused by the rays of light being conveyed to the wrong eyes, the right side of the image entering the right eye, and the left the left eye, the effect being that of a wrongly mounted stereoscopic picture. It was found necessary that the right-hand image should be conveyed to the left eye, and *vice versâ*, to produce a stereoscopic effect; this was accomplished by M. Nachet of Paris, and Mr. Wenham by different methods, each having their respective merits. As Mr. Wenham's is most in use in this country, I will briefly describe it. A four-sided prism of peculiar form (Fig. 11, A) is placed in the body of the microscope, just behind the posterior combination of the object-glass (Fig. 11, B, *b*), which, when in position, it half covers. An additional body, *l*, is joined at a slight inclination to the left-hand side of the instrument, and the two bodies are furnished at their upper extremities with draw-tubes, which supply the means of making an adjustment for the varying distance between the eyes of different persons. The image formed by the left-hand half of the objective passes up the straight tube to the right eye without being in any way interfered with by the prism; the right-hand image falls on the prism, is twice reflected, and passes into the left-hand inclined tube, and in this simple manner the crossing of the images from the two sides of the objective is effected, only one-half of the pencil suffering any reflection at all, besides giving the great advantage of instantly converting the instrument into a monocular by simply withdrawing the prism. It is only due to Mr. Wenham to mention that he has, with most praiseworthy liberality, granted free and unconditional use of his valuable invention to the public.

The binocular arrangement of Mr. Wenham cannot be used with advantage with objectives of less than half an inch focal length, but several arrangements have been constructed by which both eyes can be employed in high power observations, the most noteworthy of which has been brought forward by Messrs. Powell and Lealand. This instrument does not produce any stereoscopic effect, but nevertheless greatly diminishes the fatigue of protracted observations. A still more perfect adaptation has been constructed by Mr. Wenham, in which the light in each tube has been more nearly equalized than in preceding instruments.

The stereoscopic binocular offers many advantages over the monocular instrument, not the least of which is the saving of the fatigue to the eyes from which most persons suffer in a greater or less degree when using one eye for observation. Did the binocular arrangement do no more than this it would be a great boon, but it has the valuable property of enabling the observer readily to estimate the amount of elevation and depression of the surface he is viewing, and accurately to determine the relative position as to depth of the various parts of the tissue under observation. The discoveries which we owe to this improvement of the microscope have been numerous and valuable; among the earliest were some interesting observations on the circulating system of the tadpole, by Mr. W. U. Whitney (*Trans. Micros. Soc. Lond.*, vol. x., 1862, p. 1; and vol. xv., p. 43). Several also by the late Richard Beck; among them the re-discovery of the aperture in the fang of the spider figured by Leeuwenhoek (Hoole's English Translation, vol. i., Pl. 2, fig. 19) (*Science Gossip*, 1866, p. 201).

By a slight variation of the form of the prism, Mr. Crouch has succeeded in constructing a microscope which can, by merely shifting the position of the prism, become stereoscopic or pseudoscopic at pleasure. This modification of the binocular will probably be of value in confirming certain doubtful points of structure, by giving a reversal of the parts in relief.

Further particulars respecting the construction of the microscope and the optical principles involved will be found in the "Microscope and its Revelations," by Dr. Carpenter, and "Manual of Natural Philosophy," by Mr. Charles Brooke.

The microscope being a costly instrument, it is necessary that great care should be taken to preserve it from injury. When out of use it should be returned to its

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

† "The Microscope and its Revelations," by W. B. Carpenter, M.D., Figs. 19 and 20 (Churchill).

[English Edition, Vol. XX., No. 514, pages 157, 158.]

case or may be conveniently covered with a large shade or bell-glass. The eye-pieces should be carefully cleaned, as dust upon them becomes very apparent. The object-glasses, if kept in their boxes when out of use, will seldom require much cleaning; dust on the object-glass only causes a slight loss of light, but does not make itself visible. The best material for cleaning lenses is a piece of very soft wash-leather from which all dust has been beaten out; it should be kept in a large pill-box when out of use to preserve it from dust and grit, and should on no account be used for any other purpose, such as cleaning the brass-work of the instrument. Should the object-glasses require anything beyond mere dusting, they should be placed in the maker's hands, as they are liable to injury if taken to pieces by inexperienced persons.

The sources of light for the purposes of observation will need a few remarks. When it can be procured, daylight is in every respect to be preferred to artificial sources of illumination, as by it alone can colours be perfectly seen and distinguished, and daylight observations are far less fatiguing than those made by lamplight. Direct sunlight should be avoided, and, if possible, the light taken from a white cloud. But in towns, as the sky is seldom visible, and, moreover, few persons have much time to observe by daylight, it becomes important to seek for a good source of artificial light.

Gas has been used by many microscopists; it has the disadvantage of giving out a large amount of heat, and the quality of the light is inferior to that obtained from most other sources; its sole advantage is its convenience, as it is always ready for use, and requires no trimming, as is the case with lamps.

Well constructed lamps burning colza oil give a light of good and pure quality, although not as intense as those presently to be described. The best oil-lamp I have used was obtained from Mr. Pillischer, and was only abandoned for the very intense camphine lamp. Oil-lamps require great care in trimming and cleaning, otherwise they will not burn well.

The mineral oils (paraffin, belmontine, &c.), when of good quality, and consumed in properly constructed lamps, are among the best of the microscopist's means of illumination. The quality of the light is good, and there is very little trouble required in keeping the lamp in good working order. The glasses, as in all lamps, should be kept clean, otherwise much light is lost, and to obtain the best possible effect the lamp should be trimmed each time of using, although it will burn very well two or three times without any attention. The best way of obtaining a good oil is to try small samples from various shops, and when a good one is found keep to its use. The burner exercises a very great influence upon the light, so great that in a series from various makers it would hardly be supposed that they were burning the same oil. The burners of American make supplied by Mr. Collins with the Beckett microscope lamps (Fig. 12), are some of the best that I have met with. This lamp has recently been improved by the adaptation of a metal chimney which is not liable to breakage, and also has the advantage of protecting the eyes of the observer from the light.

The best light of all for those who do not mind the slight amount of trouble attending its use is obtained from the combustion of camphine or highly rectified spirits of turpentine in a small lamp, especially constructed for the purpose by Mr. W. Young. The light is much whiter and more intense than that of any other lamp; owing to this quality the flame can be very much reduced in size, and most of the heat of a large lamp avoided, a matter of importance where the lamp is often placed near and below the face of the observer.

Camphine, when not used quickly, should be kept in small bottles, filled up to the neck, and closely corked, and kept in a cool place—a wine-cellar answers admirably. For the small consumption of the microscope lamp the bottles should not exceed four or five ounces, as the spirit rapidly deteriorates by exposure to the air both from evaporation and the absorption of oxygen, which renders it liable to clog the wick and reduces its illuminating power. The wick should be cut very exactly to a level, far more carefully than would be required for oil or paraffin, the least uneven point rendering the lamp liable to smoke. No more camphine than is likely to be consumed should be placed in the lamp; if there is more than is needed it should be allowed

Fig. 12.

to burn itself out, or be thrown away, and the wick allowed to burn dry, otherwise the lamp is liable to become clogged, and burn badly. Should any part of the lamp become incrusted with a resinous deposit, it must be cleaned with methylated spirit; care should be taken that none of the air passages are obstructed. Although these precautions may seem troublesome, they really are not so to persons willing to acquire the habits of neatness so necessary to those who would make good microscopists; and the slight extra trouble is amply compensated by the superior purity and intensity of the light and its extreme cleanliness, it being perfectly free from greasiness or disagreeable smell. As the lamp is always kept empty it is very convenient for carrying about when it is necessary to make observations away from home.

The illuminating apparatus commonly supplied with microscopes consists of the mirror below the stage, and a condensing lens either attached to the instrument, or, as is to be preferred, on a separate stand. Other apparatus will be described in subsequent chapters.

The mirror is used for illuminating objects by directing light through them from beneath the stage, and is the usual, although not always the best, means of lighting an object, as it is one which we are unaccustomed to, and, without special precautions, is likely to lead into error. The mirror is capable of being moved out of the axis of the instrument, and light may be directed very obliquely upon the object, which is sometimes advantageous.

The condensing lens is used to concentrate light upon the object from above, and, when it can be employed, it is always preferable to commence an observation in this way rather than by means of transmitted light, as it accords more closely with our every-day way of viewing objects: it is not our usual custom to hold up a substance we wish to examine and try to look through it, but we generally allow the light to fall naturally upon it. If a plano-convex lens, or "bull's-eye," be used as a condenser, it is necessary to be careful which side is turned to the source of light, otherwise it may be used in a position causing a great amount of spherical aberration and consequent loss of light. A plano-convex condenser should always have its curved side turned to the source of light when used for concentrating light upon an object. When used for rendering divergent rays, such as those of a lamp, parallel, which is often required when using apparatus hereafter to be described, the bull's-eye should be placed with its flat side to the lamp and at about the distance of its focal length.*

The beginner is recommended to commence his observations by endeavouring to procure a good and brilliant illumination with the condensing lens, looking at any easily procured objects, such as fragments of paper, feathers, sand, &c.; a humming-bird's feather or wing of a butterfly is particularly useful, as either of them presents very different appearances, according to the direction of the illuminating pencil, the iridescent colours of the first and the imbricated structure of the second not being seen unless the light is made to fall in the proper direction. The light should be moved or the object turned round, and the varied appearances carefully noted. This precaution should be adopted with all objects viewed by reflected light.

In commencing observations by transmitted light, the student may profitably examine air-bubbles in water, easily procured by shaking up a little very weak gum-water in a bottle, and also globules of oil in water, of which milk furnishes a good and readily-procured example. A little of each of these should be placed on a separate slide, covered with a thin glass and examined by transmitted light, the air-bubbles with an inch objective; the milk may probably require a $\frac{1}{2}$ or $\frac{1}{4}$.

The leading characteristic of the air-bubble is its broad black margin when examined by transmitted light. If the laws of refraction are considered, it will be evident that a bubble of air in water will act precisely as a double concave lens, Fig. 4, B, and by its dispersive power scatter the rays of light, especially at the part where its power is greatest—the margin. The same effect may be produced, on a large scale, by holding to the light two plano-concave lenses of glass with their hollow sides placed together; this will almost exactly represent the air-bubble in water, differing only in the glass having a greater refractive power than the water in the microscopic slide, and dispersing the light rather more powerfully.

The oil globules of the milk exhibit a brilliant spot of light in their centre when slightly beyond the focus of the microscope; this is owing to their being more refractive than the surrounding medium: their action is that of double convex lenses, Fig. 4, A, and the bright spot is an imperfect image of the source of illumination, which is rendered visible when the focus of the microscope coincides with that of the globule, which will be when the instrument is slightly above the focus for distinct vision of the globule.

These appearances should be carefully studied and remembered, as bubbles of air are among the most frequent of the intrusive substances to be met with during microscopical observations; cells filled with oil and globules of oil are also of frequent occurrence in tissues. Besides these, the student should make himself acquainted with the microscopical appearance of fibres of cotton, wool, flax, &c., hair of cats and other animals, all of which are frequently found in the dust of our apartments, and of course in our microscopical preparations, unless more than ordinary care is taken to prevent their intrusion, so that it is well to know them that they may not be mistaken for characteristic portions of the substance under observation, a not unlikely error on the part of inexperienced observers.

A sample of dust from the walls of an office in the Bank of England, where it had accumulated for more than ten years, consisted of about one-half cotton fibres, probably derived from abrasion of paper; the remainder consisted of fibres of wool and flax in small quantities, and soot and grit; molecular motion was apparent when examined in water with a power of 400 diameters. An interesting paper "On the Microscopical Examination of Dust" was read by Mr. J. B. Dancer before the Literary and Philosophical Society of Manchester, January 26th, 1869.

The subject of the present chapter may be considered rather as mechanical than microscopical; in fact, it relates more to the workshop than to the study. It may, perhaps, seem strange to write about making apparatus and preparing materials in these days when nearly everything can be bought often better and more cheaply than it can be made at home, and when it is not as it was within the memory of many microscopists, who were obliged to cut their glass slides, or, at all events, to order a glazier to make them: but the more dexterous a person is with his fingers the better microscopist he is likely to make. Very often the success of an observation depends upon the observer being able to make some little contrivance to aid his researches, and it is for that purpose that the subject of the mechanics of the microscopical laboratory finds a place here.

The first material that engages the attention is glass. It comes under notice in several forms—the plates of glass upon which objects are mounted, the thin covering glass, and glass tubing. The glass generally used for mounting objects is a description of glass known as patent plate. Crown glass is sometimes used, but patent plate is perhaps the best. It is made from that commonly known by the name of cylinder glass, which is manufactured by the glass being blown, first of all, into a globe, then, by dexterous manipulation on the part of the workman, it is elongated, and a cylinder is formed. This cylinder is ripped up, and put in an annealing oven: it unbends at the slit, and rolls itself out flat. In this state it is known as sheet or flatted glass. The glass then undergoes the same treatment as plate glass. It is ground down and polished, and then it becomes the patent plate. It is a thin glass, with a beautiful surface, so accurately worked that the plates will adhere together if pressed, just as good specimens of ordinary plate.

The tool used for cutting glass is the well-known

* Each lecture was followed by a practical demonstration, during which various objects, &c., were examined and processes in manipulation carried on under the superintendence of the lecturer and assistants. Much of the subject-matter of these demonstrations will be incorporated with the text: such portions as cannot be so given will be added at the end of the various chapters.

glazier's diamond. It seems to have nothing in common with ordinary cutting tools: an incision or scratch with a diamond or other instrument, such as a flint or chilled-steel point, will not make the clean fracture we are so familiar with when the cutting diamond is used by a skilled hand. The diamond would seem rather to act by inducing some molecular displacement than by any actual penetrative power that it possesses. This view would seem to be supported by the appearance presented by the glass adjacent to a diamond cut when examined by the microscope with the aid of polarised light, which shows that the glass has been subjected to some kind of strain. Rubies and sapphires, if worked to the form of the natural edges of the diamond crystal, will cut glass, but lose the power when the curved edge wears away. A very interesting paper on the fracture of glass and the action of the diamond, by Mr. F. H. Wenham, will be found in the *Microscopical Transactions* for 1868, p. 105. (See also *Holtzapfel*, "Turning, &c.," vol. i.)

There is some little art in using the cutting diamond: it is not any part of a diamond that will cut. It is very easy, indeed, to scratch with a diamond, but it is only in certain directions that it will make the so-called cut. The Glazier's diamond (Fig. 13), when viewed under the binocular microscope, will be found to exhibit a well-defined and slightly curved edge, *a*, *b*. The diamond is carefully set so that this edge (which is a natural crystalline one) lies parallel with the oblong mounting, and, as the diamond requires to be held in an inclined position to secure a clean cut, the top of the setting is always bevelled to the proper angle. It is allowed a little play horizontally on a pivot, so that, upon placing the diamond in contact with a rule, it will

Fig. 13.

always place itself in the cutting direction, and, by keeping the end of the setting parallel with the glass, it will be in a position for cutting. It is then drawn along; and those who have seen a glazier cut glass will remember the curious noise which accompanies the operation—something between a ringing and a hissing: the sound is very different from a scratch. The glass breaks at the place upon being bent. With a little practice, the cutting of glass will be very easy indeed; but it is not worth while, as a general practice, to cut slides, as they can now be bought at a cheap rate: it is chiefly for exceptional purposes that facilities for cutting glass are of value. Sometimes a piece of glass of extra size or unusual shape is required, and then time is often saved by being able to do the work, instead of waiting until the services of a glazier can be obtained.

The other kind of glass employed in mounting objects is the thin glass for covers. The details of its manufacture are unknown to me. It is remarkable for its extreme brittleness. In cutting, the glazier's diamond is not employed, but a splinter known as the writing diamond. The operation is attended with some difficulty, as the glass is very likely to crack and star under the diamond. This is best prevented by placing the thin glass to be cut on a piece of wet plate-glass, which affords support, and effectually prevents splitting and cracking. As in the case of 3×1 slides, it is hardly worth while to cut up squares and circles of thin glass, as it can be easily procured of the opticians already cut into the most useful sizes, or, if required in large quantities, of the wholesale glass warehouses. Of course pieces of unusual sizes and shapes are sometimes required, and then the power of cutting becomes of value.

The writing diamond is also used for making marks and writing on glass. Some persons write the names of their objects on the glass instead of on a label: it has the advantage of durability, but is not so legible as an inscription on paper.

Sometimes it is required to drill a hole in a piece of glass. This is a matter of no very difficult accomplishment. A good hard drill, if it is kept moistened with turpentine, will, with a small amount of patience and labour, eventually work its way through a piece of glass. Care should be taken that the glass rests upon a cork bed, or something soft, but yet firm, to give it sufficient support, or it may break just before the point of the drill makes its way through. Perhaps the best plan is to begin on the other side when the drill has penetrated about half-way. Some persons are of opinion that dilute sulphuric acid, in the proportion of eight parts of water to one of acid, serves for moistening the drill better than turpentine. Of course the fluid used is the reverse of a lubricant: if oil were employed, the drill would not cut. The drills are best hardened by heating to redness and cooling suddenly with strong sulphuric acid. The edge requires working up from time to time upon an Arkansas stone, with oil. In drilling a thick piece of glass, the drill may require setting once or twice during the process; but I have never had any difficulty in drilling through a thick piece of plate.

The rough, sharp edges left on glass after cutting with the diamond may be removed by grinding with fine emery and water upon a smooth paving stone or thick plate of zinc: the glass-cutters usually employ emery upon a lap or horizontal wheel.

For many cutting processes, tools made of corundum and shellac are very useful; this composition, in the form of wheels, files, hones, &c., of several degrees of fineness, can be obtained of Mr. D. Lyon, 43, S. John's Square, Clerkenwell, E.C. These tools, especially the wheels, are employed by dentists, in cutting and shaping the semi-vitrified porcelain used in the manufacture of artificial teeth. The use of the corundum composition in this country is comparatively recent, although it has been employed for centuries by the native jewellers of India.

Corundum is a crystalline mineral, identical, or nearly so, in composition with the sapphire, ruby,

topaz, and amethyst, equally hard, but wanting in transparency and lustre. Emery is nearly similar, but occurs in a granular form, and does not cut so well, although there are many purposes for which it is more serviceable than the harder corundum.

These tools must be plentifully supplied with water when in use, as, unless kept cool, they soon lose their shape, which would be the case if used dry, as they would rapidly heat and melt with the friction of rasping and grinding a hard substance.

Glass plates may be smoothed, and even rounded at the edges, with the greatest ease, with a corundum file, and almost as quickly as brass could be filed. A tapering tool is useful for enlarging a hole drilled in glass; and the hones serve for grinding sections of substances too hard for the ordinary stones. As the material becomes better known, many other uses will, no doubt, be found for it.

Glass is frequently used by the microscopists in another form, that of tube. It is chiefly employed in making the dipping tubes, with which objects such as free swimming animals and deposits in water are taken up, and for the pointed tubes, or pipettes, with which small portions of fluids are removed and deposited where they may be needed. The manufacture of these bent tubes, or pipettes, is not a matter of difficulty. The processes of drawing glass tube to points, and bending, are very frequent in the laboratory. The best source of heat is obtained from the Bunsen burner, which gives a very large flame without smoke and of great heating power by the consumption of a mixture of air and coal gas. It can be obtained of the chemical instrument makers for a very small sum; a spirit lamp, however, will answer the purpose tolerably well if the wick is a large one. A piece of glass tube, in which it is intended to make a bend, should be heated to a slight redness, and then carefully and slowly bent to the required angle. If an attempt is made to bend a tube suddenly, it will produce a choke, or contraction, in the bend. It is also necessary to heat a considerable length of tube. Pieces of glass tube are very easily detached, by making a notch on them with the edge of a file, and they are then sure to break straight across; any length of glass tube can be cut off in this way. The process most frequently required to be performed by the microscopist is the drawing tubes out into pointed ends for pipettes. To effect this, heat the tube in the flame; when the tube has become sufficiently soft, it can be drawn out to any length and fineness you please. The rough edge at the cut ends of tubing may be taken off by heating the ends in the flame, which will melt the edges and leave them rounded. This rounding of the edges is, perhaps, effected more rapidly by using a blowpipe, which facilitates the fusion of the glass. Sometimes a pipette curved as well as pointed is required; there are many purposes for which it is extremely useful. This is easily made by a little variation of the other process; while it is being drawn out, give it a skilful bend at the proper moment. Always keep tubes of glass revolving while they are being heated, and do not heat them more than is absolutely necessary, as, when the tube is made very hot, it is extremely pliable, and likely to lose its shape. With a little ingenuity a number of useful things may be made out of glass tube. A variety of these pipettes will be found useful, and they are rather expensive to buy.

Glass, whether in the form of slides or thin glass, always requires cleaning. The best cleaning fluid is methylated spirit, which, as it is not subject to duty, and can be obtained cheaply, may be made free use of for this and nearly all the operations of the microscopist in which strong alcohol is required. Care must, however, be taken to obtain pure methylated spirit, and not what is commonly known as "methylated finish," which contains a small portion of shellac in solution, and is quite useless for all microscopical and laboratory purposes, and which is not unfrequently sold when methylated spirit is enquired for. I am indebted to the Rev. J. B. Reade for the history of this adulteration. Formerly, methylated alcohol was allowed to be sold without a license; but certain persons, finding that it was cheap, and not being particular about the flavour of methylic ether, used it for making grog. This fact coming to the knowledge of the excise authorities, its sale by unlicensed dealers was prohibited, unless containing shellac in solution, a mixture which would not spoil it for its chief use, that of varnish making, while, upon mixture with water, the gum would be precipitated, making a very disagreeable turbid compound. There is no difficulty in obtaining pure methylated alcohol in large towns, where one or more licensed dealers are generally to be found. It can be obtained perfectly pure, either in large or small quantities, of Messrs. Jackson and Townson, Bishopsgate Street, and of most other dealers in chemicals. It should not leave any residue upon evaporation, or become turbid when mixed with water; any spirit having these defects should not be used for microscopical purposes.

Great care should be taken that the cloths used for cleaning glass be perfectly free from soap or dirt, otherwise they will leave the surface of the slide covered with striæ. Old linen, or cotton cloths, are to be preferred to new ones; they should, before use, be boiled in water and common washing soda, to remove all soap left from former washings. They are then to be washed several times in clean water, until all trace of the soda is removed, and then dried, but not ironed, as the rough fluffy condition they will be left in is extremely favourable for cleaning glass. After the spirit is cleaned off with the cloth, any fibres that may be left from the cloth should be removed with a soft wash-leather.

Thin cover glass is treated in a similar manner, but, on account of its excessive brittleness, requires great care in cleaning. After a little practice, it is quite easy to rub it with the cloth and leather between the thumb and finger; but, should any difficulty be experienced, which may be the case with the thinnest kinds, it will be found that it can be rubbed with considerable force, without injury, between two discs of wood covered with wash-leather. The great thing in rubbing a brittle substance is to support it well behind: this is the whole secret of cleaning thin glass between the finger and thumb.

For joining together pieces of glass, and for attaching metal to glass, the cement known as marine glue is usually employed. It consists of india-rubber, shellac, and coal naphtha, combined in various proportions, according to the purpose for which it is intended to be used. It is, I believe, difficult to make in small quantities; but there is no trouble in obtaining it, as it is sold by most microscope makers. As this cement will only adhere to hot surfaces, it is necessary to have some means of applying a steady heat to the pieces of glass, &c., to be joined; and as this cannot be done by means of the unprotected flame of a lamp, a hot-plate is generally employed. This can be obtained, ready

made, of the opticians; but a piece of thick brass plate, about 6 or 7 inches long and 2 inches wide, placed upon one of the rings of a retort stand, will answer admirably; it can be heated by means of a spirit lamp or gas flame placed underneath. Supposing, for example, it is required to attach a ring of glass or metal to a glass slide, to form a cell for an object to be mounted in. The glass slide is placed upon the hot-plate, first of all, at the part most distant from the lamp, to avoid breaking it by too sudden heating, and then moved gradually to the hotter part; the ring is also heated on the plate, a piece of marine glue is held on the point of a needle in a handle, or other convenient holder, and rubbed on the heated glass over the surface to which the ring is to be attached. When a sufficient portion of glue is melted on the glass, care being taken to heat the glue sufficiently for free working, while overheating amounting to boiling is to be avoided, the heated ring is then lifted on with a pair of forceps, which, for this and all other purposes where they are likely to be made hot, should be of brass, or else an old pair of steel forceps, which are to be kept for such uses. The ring is then to be turned round backwards and forwards on the glass, to spread the cement equally, and then removed from the hot-plate and pressed on a piece of wood, to expel superfluous glue, and allowed a little time to set; when set, but still warm, the greater part of the cement can be scraped off with a blunt knife, a process much more difficult if it is allowed to become quite cold. A number of cells can be attached and roughly cleaned at one time, the plate next required being heated while the one cemented is being cleaned off. When quite cold, the slides can be thoroughly cleaned with a piece of rag and a free use of methylated spirit; they should then be rubbed bright with a clean cloth. Some persons use liquor potassæ for cleaning off superfluous marine glue; it does this very effectually, but not so rapidly as strong alcohol, and the operation is a rather unpleasant one, as the alkaline solution first softens, and then removes the skin from the fingers.

The adhesion of marine glue, and other cements, to glass surfaces, is much improved by grinding, which gives the cement a better hold than it would have on a polished surface, although marine glue will adhere well to polished glass, provided the surface is free from grease, which may be insured by a cleaning with methylated spirit. The adhesion of two pieces of glass cemented with marine glue is so perfect that they generally break in any place rather than at the joint.

A very useful trough for viewing objects in fluid can be made with a slight amount of trouble. Cut in half an ordinary 3 × 1 slide (Fig. 14, shaded portion in centre). From this cut off the strip *a*, then the pieces *b* and *c*, and reject the centre piece, *d*. Before cutting, it is well to mark the adjacent edges with ink, as indicated in the figure, to prevent any mistake in putting them together afterwards. The three pieces, *a*, *b*, and

Fig. 14.

c are to be cemented with marine glue on the middle of a slide, and, as the cut portions, if replaced as directed, fit each other accurately, there is no occasion for grinding. The trough is completed by fastening an oblong piece of thin cover-glass on the upper surface. For this purpose it is better not to use marine glue, as the cover frequently requires removal, as, from its thinness, it is liable to be broken in cleaning. It can be best secured by the use of the following, known as "electrical cement," from its having been used to fasten various portions of electrical apparatus together:—Melt together five parts rosin, one part bees'-wax, one part red-ochre, two parts Canada balsam; mix well, and pour into pill-boxes of convenient size. This cement is most conveniently used with a miniature soldering bit, which is rendered more comfortable to use by its being balanced with a plug of lead in the handle. With a little practice, a very neat joint can be made. The cement is also useful for many other purposes, of which notice will be taken in the proper place.

Larger troughs, having sides of plate-glass, can be made by those who will take the necessary trouble. In this case, the surfaces to be cemented must be ac-

Fig. 15.

curately ground. Such vessels are very useful in looking over the results of pond-hunting with a low power for the purpose of selecting such objects as may be required for more detailed observation. The troughs, of various shapes, can be purchased at most opticians.

The form represented in Fig. 15 is particularly convenient, as by means of the whalebone spring, *f*, and the wedge, *g*, the space between the front glass, *b*, of the trough and the inclined plate, *c*, is capable of adjustment, so that an object can, when desired, be kept close to the front glass. These parts can be removed when a greater depth of water is required for larger objects.

A simple and useful contrivance, to be used as a growing-slide, has been described by Mr. C. J. Muller (*Monthly Microscopical Journal*, vol. i., p. 174). The object of a growing-slide is to keep alive any minute water-plant or animal, the development of which it is wished to observe. Many plans have been devised for this purpose, but none equal in simplicity or efficiency that now to be described.

An ordinary 3 × 1 slide (Fig. 16, A) is pierced with a

Fig. 16.

A

B

minute hole at about 3-10ths of an inch from the centre

on one side. When an object under investigation is put upon it immersed in water, the thin glass cover is so placed as to include this hole, which should be near its margin. When it is desired to keep the specimen moist while off the stage of the microscope, the slide is placed in a small flat trough (B) in an oblique position, object uppermost, with one end (that nearest the hole) resting against the bottom of the vessel on one side, and the other resting upon the edge of it. Sufficient water is put into the vessel to admit of the liquid reaching within a ¼ or ½ an inch of the glass cover on the uppermost side, when it will be found that the water on the under side reaches beyond the centre of the slide, and consequently beyond the hole with which it is pierced. In this state, the object will remain moist so long as the trough contains a sufficient quantity of water. When required to be placed on the stage of the microscope, the water is easily wiped off the slide, without any disturbance of the object.

Mr. Muller's original trough was made of tin-plate, but, as this material is liable to rust when long in use, Mr. F. W. Gay has had them made of pewter of an improved form, which has proved an effectual remedy for this defect. Thus constructed, they are to be obtained of Mr. C. Baker, Holborn.

The process of attaching cells to plates of glass has been given; but nothing has been said about the material of the rings forming the cells. When required of some considerable depth, rings made of slices cut from thick glass tubing answer admirably. If square or oblong cells are required, they can be cut from tubes of suitable form. Very useful cells are now made by Mr. Collins of pure tin of various thicknesses, from that of thin writing-paper up to that of a thick tube cell: several sizes can also be procured in each thickness. Tin is not acted upon by any of the fluids used in preserving microscopical objects, and has the advantage of being much cheaper than glass, and at the same time equally efficient. Cells of unusual form can readily be cut from the sheet-tin with a penknife or pair of scissors, and circles can readily be punched. The adhesion of the cover-glass is improved, and the process of mounting in fluid much facilitated, by grinding the upper surface of the cell after it is attached to the slide with water upon a Water-of-Ayr stone, as suggested by Dr. Carpenter. This gives a beautiful surface, and ensures the perfect fit of the cover, and renders the closing of the cell a matter of greater certainty than it would be if the natural surface of the metal were used.

Some very useful aids to the examination of microscopical objects, and which can readily be made by the exercise of the smallest amount of mechanical ingenuity, are described by Mr. S. J. McIntire, in the *Transactions of the Quekett Microscopical Club*, vol. i. p. 69. One of these is of such general application that it will be well to describe it. A piece of sound sheet cork, about 2 in. by 3½, or other convenient size, and of a thickness suited to the purpose for which it is intended, is perforated with an oval or circular hole; this may easily be cut with an oval or sharp chisel, and the edges finished with a file. The cork is placed between two pieces of glass of similar size, the lower one being covered with a few layers of pink blotting paper, and the whole contrivance kept together with two india-rubber rings. The cell so constructed is used for keeping alive small insects that inhabit damp situations, such as *Podurœ*. The moisture is readily supplied by dipping the end of the slide into water, which is absorbed and retained by the blotting paper. The proper food of the insect can be placed in the cell. By the aid of this simple contrivance, Mr. McIntire has been enabled to make some most interesting observations on the habits of the *Podurœ*, which have been kept living in these cells for many months. This plan admits of modification to suit the object under observation. In the author's researches on the blow-fly, it was necessary to use thin glass, and to have the means of viewing the object on either side; this was accomplished by cutting a rectangular hole in a suitable piece of cork, placing the thin glass on either side, and securing it by bending on its edges strips of the sheet tin used for making cells which had been inserted in the cork, which effectually fastened the glass in a somewhat similar manner to that by which a stone is set by jewellers, and readily permitted its removal when required.

Among the tools employed by the microscopist, none are more generally in request than needles of various sizes and forms. They are frequently required of various curvatures; this bending can readily be performed by the microscopist himself. If a needle is heated to redness in the flame of a spirit-lamp, and allowed to cool, it can easily be bent or twisted into any required form. Steel so treated, if heated again to redness and suddenly cooled in water, becomes excessively hard and brittle; in this condition it is capable of scratching glass, but is too fragile for dissecting instruments. The right temper for the dissecting needles is obtained by heating and cooling in tallow or oil; this, with needles, may be readily done in a common tallow (not composite or paraffin) candle. While the needle is soft, it may, by the exercise of a little dexterity, be hammered out so as to form a small knife or lancet, which can then be hardened so as to take a cutting edge; many useful instruments can also be made out of small pieces of steel. Needles and cutting instruments are best sharpened upon a very hard, white stone, known at the tool shops as Arkansas oil-stone; it cuts very rapidly, and gives an extremely fine edge. Scissors, when blunt, may readily be sharpened on the oil-stone, by opening the blades and rubbing them on the stone, holding them nearly upright. The burr produced by this operation need not be ground off, as it is soon removed when the blades are worked together; the screw is to be tightened if required. For delicate dissections, the steadiest cutting instrument is a kind of scissors, made almost exactly like a minute pair of sheep shears, and known as the microtome; in use, it feels very much as if the fingers were extended and armed with cutting edges. There is hardly any other cutting instrument so much under the control of the operator.

The best handles for needles and other small instruments are made of cedar pen-holders, into which the needle, with the eye broken off, is inserted with a pair of pliers. Very convenient handles, which have the advantage of allowing the needles to be removed at pleasure, are to be purchased at fancy warehouses; they are used for holding crochet hooks; they are improved by the removal of the ivory handle, and the substitution of one made of a cedar pen-holder, which can easily be attached to the metal socket with electrical cement, and will be found to be lighter and more pleasant in use.

The processes connected with the preparation and preservation of microscopical objects have always occupied a considerable space in nearly every work on the use of the instrument. The subject is one of general interest, and the importance of being able to

preserve specimens for future reference can scarcely be overrated.

The simplest of these processes, and also the oldest, is that known as "dry-mounting."

The objects suitable for mounting dry are those which can be preserved in air and are capable of being dried without injury to their structure. The ways of mounting are extremely numerous, and are principally means of protection from the great enemies of all natural history preparations—damp and dust. One of the oldest ways of mounting objects was upon discs punched from a compound sheet of card and wash-leather, through which a pin was run for convenience of holding in the stage forceps and keeping in a cork-bottomed drawer. This plan of mounting was abandoned when the lieberkuhn fell into disuse, but it has since been revived in a new form by the late Richard Beck, who invented a very ingenious instrument for

Fig. 17.

holding the small discs of metal and turning them into any required position. This is an extremely useful piece of apparatus, as it is often required to turn an object into several positions for the thorough examination of its structure. So perfectly is this accomplished, that five out of the six sides of a cube may be examined by means of the revolving disc-holder. This instrument has supplied a want created by the introduction of the binocular microscope, as the greater focal depth and stereoscopic effect given by it has rendered advantageous frequent changes of the position of objects, for which this contrivance most effectually provides. For the keeping of the discs from the influence of dust and damp, he contrived a close-fitting screw-box, having suitable arrangements for the reception of twenty-four discs.

Great use has also been made by some observers of open cells. These consist of a hole bored in a 3 × 1 slide of wood, with a piece of card-board glued to the bottom, the objects being fastened with a little gum. This answers very well with objects not liable to injury from exposure, such as shells; but, for most purposes, it is necessary to close up the object, and this, in many instances, is done in a manner very detrimental to its preservation. Wherever paper and paste or gum are used, various fungi and confervæ are nearly sure to make their appearance, unless special precautions, such as saturating the paper with, and mixing in the gum, a small quantity of corrosive sublimate. The microscopical fungi are doubtless interesting plants, but, when they grow over valuable preparations, we feel them to be a nuisance, and decidedly in the way.

Some microscopists, avoiding the use of paste, gum, and paper for securing the cover to the slide, have made use of varnishes of several kinds. These generally have the defect, if thin, of running in between the glass and cover and spoiling the object, and, if thickened with a solid substance, such as lamp-black or vermillion, of becoming porous after a time. Some of the fluid medium of the varnish, also, is liable, in drying, to rise in vapour within the cell, and condense on the cover, interfering with the distinct view of the object. The vapour of turpentine or naphtha, however, is in no way otherwise detrimental, as it tends rather to the preservation than the destruction of tissues.

The electrical cement previously described (Chemical News, vol. xx., p. 181. *Am. Repr., Dec.*, 1869, *p.* 326) is free from this defect, and furnishes a means of rapidly mounting objects either with or without a cell. If the object is very thin and flat, it may be placed upon a slide, and a thin glass cover put over it. Both having been carefully cleaned, one of the spring clips made of wire and cork (which are to be procured of most opticians) can be used to hold the cover in place while the cement is being run round it with the little brass bit. The bit should not be made too hot, or it will not hold the cement. After the cover has been fastened down, the rough cement can be smoothed by passing over it a clean bit heated rather more than is required for laying on the cement. The bit is easily cleaned by wiping while hot upon a piece of blotting-paper. The first attempts, no doubt, will be far from elegant in appearance; but, after a little practice, great neatness may be attained. This process is also available for attaching the cover to cells of metal or glass, which must be used with dry-mounted objects whenever their thickness is such as to require it. This mode was formerly much employed, but was abandoned on account of the brittleness of the cement. This may be remedied by varnishing, when the cement has become hard, with gold-size, which is remarkable for the tenacity with which it adheres to glass and its toughness and non-liability to crack. Respecting the properties of this varnish, more will be said in the chapters relating to fluid-mounting. This system of compound cementing answers perfectly; the electrical cement having, in the first instance, no tendency to run in, and the gold-size effectually keeping it from separating from the glass. If the natural red colour of the electrical cement is objected to, a black finish can best be obtained by the use of lamp-black as prepared for water-colour painting. The best form is that in tubes. A little of this is pressed from the tube, and, if too thick, a small quantity of water added. With this the varnished surface is thickly painted, and, when dry, a few coats of gold-size will keep it from being washed off. The result is a dense, lustrous black, very superior in effect and durability to that produced by a black varnish. This finish is equally available for fluid and balsam mountings.

If the object cannot be kept in its place by the pressure of the cover glass, it will require fastening. If the object will bear a slight amount of heat, a small spot of electrical cement may be placed on the glass, melted by holding over a lamp, and, while soft, the object fixed. Or the thick varnish composed of shellac and wood-naphtha, sold at most varnish-shops as liquid glue or "patent knotting varnish," will be found useful for this and other purposes to be mentioned hereafter. Care must be taken to allow the naphtha time to evaporate, or its vapour will obscure the cover. While this drying is taking place, the slide may be turned face downwards over a large pill-box, or the cover put on, and kept in place with a spot or two of electrical cement, deferring the completion until the varnish has dried.

It is not necessary to employ any kind of black background for opaque objects, the best background being that of the dark-well beneath the stage, formed by bringing round that part of the diaphragm-plate which has no hole, and so closing up the aperture. If a black

patch is used, it prevents advantage being taken of various kinds of illumination from beneath, which are often of great service, while the mounting on clear glass is in no way detrimental to the view of an object lighted from above.

It is necessary that the object to be mounted should be perfectly dry before it is placed in the cell, otherwise moisture will, sooner or later, make itself apparent.

Most objects can be dried by the application of a moderate heat. If wrapped up in a piece of paper, and placed inside the fender, in an hour or so they will be found to be effectually dried. A Seidlitz-powder box answers extremely well for this kind of drying: it can be still more effectually accomplished by means of the well-known hot-water oven.

There are cases, however, where heat is inadmissible, especially with delicate tissues. The desiccation of these is best accomplished in a vacuum. The substance to be dried is placed under the receiver of an air-pump; the air is exhausted, and, under these conditions, it will give off vapour at a much lower temperature than under ordinary atmospheric pressure. It is only necessary to provide some means of absorbing the watery vapour as fast as it is given off—such as concentrated sulphuric acid or dry lime.

Another, and very effectual mode of drying delicate tissues without heat, is the process described in the Chemical News (vol. xiii., p. 122, *Eng. Ed.*), translated from *Zeitsch. für Anal. Chemie.* This process, which is quite new so far as its application to microscopical purposes is concerned, consists in immersing the substance to be dried in ether in the presence of dry chloride of calcium. The apparatus employed is simple, consisting of a wide-mouthed stoppered-bottle, at the bottom of which is placed some chloride of calcium. A slice from the bowl of a tobacco-pipe forms a support for a Berlin crucible and cover, in which the substance to be dried is placed. The whole is then covered with ether (the methylated answers very well for the purpose), and the mouth of the bottle closed. The ether absorbs water from the tissue, which is again absorbed by the chloride of calcium, and the process goes on without attention until the chloride of calcium ceases to absorb. The results, as far as at present ascertained, have been very satisfactory. Cellular tissue (fresh potatoe) has been dried without any contraction. Flies' heads have contracted less than by drying in air; the eyes were in very perfect condition, and gave good results upon a section being cut; the striation on the muscular fibre was perfectly preserved. A small spider, treated by this process, was dried without any shrinking of the abdomen. Those substances which are injuriously acted upon by ether cannot, of course, be dried by this process; but it is evidently a very valuable addition to the microscopist's resources.

When the object is removed from the drying apparatus, the ether dries off in a few seconds. If it is required to preserve the object in balsam, it can either be mounted at once, wet, with ether, or transferred to benzole or turpentine.

In the old days of microscopic manipulation, no means was known of preserving objects but that of mounting them dry. The usual plan was to mount about six objects in an ivory slide, between discs of mica, secured with a brass ring: thin glass was unknown at that time. Mounting in Canada-balsam was, after this, hailed as a very great improvement. Whether the idea was suggested or not by insects preserved in amber there are no means of ascertaining. Very often ideas are suggested by natural occurrences, and it would seem likely that some attempt might be made to imitate these specimens of Nature's mounting. Gum and various varnishes were tried, until, at last, Canada balsam was found to succeed.

Canada balsam may be considered as a natural varnish. It is one of the substances known as oleoresins, and is, according to the "Micrographic Dictionary," the product of *Pinus Balsamea*, although, possibly, it may be obtained from more species of the *Coniferæ* than one: something nearly similar is found in every pine-wood—the turpentine exuding from many of the trees. Canada balsam, like some other varnishes, possesses a power of drying more or less readily according to circumstances. It dries more quickly at a moderate heat than otherwise; is readily soluble in ether, turpentine, and benzole; and possesses the advantage of being highly refractive—nearly as much so as glass, thereby rendering the view of the edges of objects clearer when examined by transmitted light, by diminishing the diffraction—that power which light seems to have of going round a corner under certain circumstances, and which causes objects, under high powers, to show ill-defined margins when viewed in air. Canada balsam is also capable of soaking into tissues, and rendering them much more transparent than they would otherwise be. A much clearer view of the interior of semi-opaque objects, and, frequently, of objects that are too dense to transmit any light, can be obtained by its means than possibly could be without it. But, while it has the advantage of rendering tissues very transparent, and, at the same time, preserving them in an undoubtedly permanent manner, it is sometimes liable to render them almost invisible by inducing an excessive transparency; it is, also, applicable only to those substances that can be dried without injury. This, of course, prohibits its use with a very large class of tissues, the minute details of many animal and vegetable structures being obliterated by drying, either by ordinary desiccative processes, or the absorption of their water by means of strong alcohol;—a process which frequently induces great contraction in a substance treated with it, but which is sometimes taken advantage of when it is required to harden a soft tissue.

The process of mounting in Canada balsam is not a very difficult one. The chief obstacles are the presence of damp and air. A few air-bubbles in a preparation are of little consequence; but, if the preparation should be mounted at all damp, it will almost invariably fail. Damp makes itself known by a kind of fog surrounding the object.

If the object to be mounted can be dried on the slide, the mounting is extremely easy. Place upon it a drop of Canada balsam; warm gently over the lamp chimney until it runs, but do not let it boil; then place the cover glass on with the forceps, letting one edge touch first and bringing the cover down gradually, so as to expel any floating air-bubbles with the surplus balsam. Should there be any doubt about the penetration of the balsam, the object may advantageously be moistened with turpentine, or, still better, camphine, if it is to be procured. Objects especially liable to retain air should be prepared by a prolonged soaking in turpentine or benzole; and, in obstinate cases, the air-pump may be used with advantage to aid the saturation with the fluid. Small air-bubbles in a preparation need not be a source of anxiety, as they speedily disappear by absorption.

[English Edition, Vol. XX., No. 517, page 194; No. 518, page 207.]

Sometimes the object may be placed upon the slide, the cover clipped down, and some balsam placed at the edge, which is then melted, and allowed to run in by capillary attraction. This plan has the advantage of causing little or no disturbance in the position of an object, and should always be used, if there is any tendency to curl upon the application of heat.

In some cases, the presence of air within a tissue is an advantage instead of a detriment. The lacunæ and canaliculi in sections of bone, and the tracheal-tubes of insects are much better shown when they are, as it were, injected with air. To retain the air, the treatment must be the reverse of that described. The balsam must be the thickest that can be procured, and the mounting done cold, or with the application of the smallest available amount of heat.

The surplus balsam around the edges of the cover will require to be cleaned off; but this must not be attempted until it has become hard and firm. The hardening of the balsam may be much accelerated by the application of heat. The inside of a fender is a very convenient place for drying balsam-mounted slides. A drying apparatus for effecting this more quickly is described by Mr. D. E. Goddard, in the *Transactions of the Microscopical Society of London*, January, 1864, p. 45.

The simplest way of removing the surplus balsam is to make it very hard, and then wet the slide, and scrape away the balsam with a wet knife. It comes off very readily, and leaves the slide so clean that it can be easily finished with a rag and a little methylated spirit. Where the balsam is not very hard, it is better to scrape away as much as possible with a hot knife, and remove the remainder with alcohol, being very careful not to disturb the cover. The knife for scraping the slide should be softened by heating to redness and allowing it to cool, or it will scratch the glass.

The forceps and needles may be cleaned from balsam by heating in a spirit-lamp, and wiping with rag or blotting-paper. The forceps should be common brass ones, as steel would soon be spoiled, and the needles kept for this particular purpose, as they are useless for any other. Balsam may be removed from the fingers by a free use of methylated spirit.

Canada balsam is best preserved for use in the collapsible tin-tubes used for containing oil-colours. As already mentioned, air is largely absorbed by balsam; indeed, most varnishes dry quite as much by the absorption of oxygen as by evaporation. The advantage of the tube as a receptacle is that the balsam is kept quite close to the top of the tube, and no air allowed to remain there, so the balsam may be preserved in a perfectly fluid state for a long period. Balsam has been kept for two years in these tubes, and been as limpid as when the tube was filled; while, in bottles, the balsam rapidly hardens, and becomes useless if long kept. The tubes have also the advantage of cleanliness in use: the supply is obtained by squeezing out the quantity required, the use of a dipper, an endless source of dirt and introduction of foreign substances, being dispensed with. Should a little balsam ooze out around the screw-cap, it can be scraped away with a hot knife. These tubes also form convenient receptacles for varnishes which are liable to injury by being exposed to the air—such as gold-size. They do not answer for varnishes made with naphtha or spirit, as these varnishes dry entirely by evaporation, and soon fasten down the cap.

Solutions of balsam in various media have been much used by some microscopists. They have the advantage of allowing the mounting of an object to be effected without the employment of heat, a great desideratum in many cases. Chloroform has been the medium hitherto employed for dissolving the balsam, which is previously exposed to a slow heat, until it is dried into a hard, resinous mass. It has been found, however, that objects mounted in this solution have frequently become cloudy, and that the solution, if kept for a considerable period, becomes turbid. Dr. Bastian recommends the use of benzole as a solvent, on the ground of its greater stability. He has made great use of the solution as a medium for making preparations of nervous tissue. A detailed account of his processes will be found in the *Monthly Microscopical Journal*, vol. i., p. 94.

The solution of balsam and benzole is most conveniently kept in a wide-mouthed bottle, with a ground cap instead of a stopper, which will allow a small pipette to be kept in the bottle. Should the fluid become too thick from evaporation, a little more benzole may be added.

Besides the use of balsam as a mounting medium, it is useful as a cement for a special set of purposes. The microscopist who makes the osseous tissues, rocks, or hard substances in general his particular study, will often require thin sections.

The preparation of a bone section will serve very well as an example of section-cutting, and polishing in general. It is required to make a very thin section of a recent bone, polished on both sides, to be mounted dry. The bone is to be cut into thin slices with a watch-spring saw. A level surface is then to be made on one side, by grinding down with water on a piece of blue-stone, or Water-of-Ayr. If the slice is very rough, time may be saved by using a file in the first instance, and finishing on the stone. The fingers may be protected from the action of the stone by bedding the rough section in a piece of cork.

The bone slices are to be cemented with Canada balsam, by their ground sides, to pieces of thick plate-glass; 1½ inches by ¾ of an inch is a convenient size for general use. The chief art consists in using the balsam of the right degree of hardness. A drop of balsam is to be placed on one of the slips, boiled on the hot plate, and allowed to cool. If, when cold, it is just capable of receiving a slight impression of the thumb-nail when pressed hard, it will do. If too soft, it must be heated again, and allowed to cool, and the process repeated, if necessary, until the right degree is obtained. If the balsam is not hardened sufficiently, it will clog the stone in the subsequent process; and, if too hard, it is liable to chip off along with the partially-finished section during the grinding. The piece of bone, cemented in its balsam bed, is to be ground down with water until the surface is levelled. It is then to be polished, so that no scratches appear upon it when examined under the microscope. This is done with putty-powder (oxide of tin, and not in any way connected with glazier's putty), used with water upon a wash-leather strop. When the polishing is completed, the section is to be removed from the glass, which can be done by dropping it into a bottle of benzole, which will dissolve the hardened balsam, and release the section in a few moments. A wide-mouthed stoppered bottle is convenient for this purpose, and the pieces of plate-glass are cut of the small size recommended, in order that they may be easily placed in and removed from the bottle. The half-finished section is now to be cemented to another balsam-bed, and ground down un-

til it is sufficiently thin. With practice, 1-500th of an inch may be attained with a tough substance like bone. The author has approached this thickness even with fossil ganoid scales from the Weald clay. At first, it is well not to attempt too thin a section, and to practise on some material of which a large supply can be obtained. When ground sufficiently thin, the second surface is to be polished, and then detached as before, and afterwards washed in clean benzole, to remove all traces of balsam. The finished sections, when the benzole has dried off, are to be mounted dry by one of the usual processes.

Sections to be mounted in balsam will not require to be polished, as the balsam fills up, and, by its refractive power, apparently obliterates the scratches left by the grindstone. Other hard substances are treated in a nearly similar manner. Fossil bones and teeth, from their extreme brittleness, will require greater care in grinding, and, from their dark colour, must often be mounted in balsam, instead of dry. This is also necessary when they have a tendency to disintegrate. For very hard substances, such as teeth, the Arkansas stone would be of great service; but, unfortunately, it does not cut well when used with water, and, if oil is employed, the balsam is softened. A process devised by Dr. Christopher Johnstone about ten years ago, and published in *Silliman's Journal*, gives a process by which an oil-stone can be employed. The cement used is isinglass jelly, made with alcohol. Use is made of thin paper, as a guard against grinding away the section—an accident of frequent occurrence with beginners. The grinding is performed upon an Arkansas stone, with oil, and hot water is used to detach the section. The grease can be extracted with benzole. A detailed account of the process is given in the *Journal of the Quekett Microscopical Club*, 1869, p. 201. Accounts of the mode of cutting rock-sections, by J. B. Jordan, will be found in the same journal, p. 186, and, by D. Forbes, F.R.S., in the *Monthly Microscopical Journal*, vol. i., p. 240. The process of cutting sections of still harder substances, such as gems, is described by Mr. H. C. Sorby in the *Monthly Microscopical Journal*, vol. i., p. 220. Grindstones and polishing powders of various kinds can be obtained at the better class of tool shops, as Holtzapffel's, Buck's, Fenn's, &c.

Although it is the usual custom to cover slides containing dry and balsam mounted objects with paper, it is preferable to leave them without. A balsam-mounted preparation, well cleaned, and mounted on a piece of good patent plate with polished edges, is far neater than when covered with paper, which too often only serves to conceal an inferior quality of glass.

(To be continued.)

ON THE

DETERMINATION OF CRYSTALLISED SUGAR.

BY JAMES BELL, ESQ.

Two processes for the determination of crystallised sugar have been proposed, one by M. Dumas, and the other by M. Payen. Both methods are based on the insolubility of crystallised sugar in alcohol saturated with refined white sugar, while inverted and uncrystallised sugars are supposed to be soluble therein.

These two processes, while differing in many important particulars, are essentially the same in the method followed in liberating the crystallised sugar, which consists in mechanically washing out, by simple agitation, the inverted and uncrystallised portion. This method of operation may be adapted for the analysis of superior qualities of sugar, but it is not applicable to low descriptions, such as "jaggery" and "concrete," or to mixtures of sugar and treacle.

In the analysis of "jaggery" and concrete," &c., simple agitation in the test liquor is not sufficient to dissolve out, and remove the whole of the inverted and uncrystallised sugars, and liberate the crystallised portion. When the proportion of inverted and uncrystallised sugars present is tolerably large, the sample possesses a considerable degree of tenacity, and, it is not practicable, by simple agitation, to reduce it into that minutely divided state which is essential to admit of the solvent power of the test liquor being brought into full action; and in practice, in order to effect a complete disintegration of the sugar, it is necessary to operate in a mortar, and to gently rub the sample in the test liquor with a pestle.

The alcohol employed in both Dumas's and Payen's processes is of a strength of 85°, or a little under 50 over proof strength, and, prior to saturation, there is added to the alcohol five per cent of acetic acid, for the purpose of decomposing and dissolving any salts of lime, &c., that may be present.

Before submitting the sample to the action of the test liquor, M. Payen removes the "2 or 3 per cent" of moisture it contains by "absolute alcohol." It is obvious that this could not be done with samples containing large percentages of treacle, such as those to which the process hereafter described is applicable, as the "absolute alcohol" could not abstract the water from them, on account of their viscidity, and even if it were possible for it to do so, the reduction in strength would be so considerable that the alcohol would have a very appreciable solvent action.

The strength of the alcohol has a very important influence upon the accuracy of the result, and, while it is desirable to keep the strength as high as possible, that the alcohol may be readily saturated with a small quantity of crystallised sugar, and that a slight reduction in strength will not materially increase its solvent power, it is, on the other hand, essential that the alcohol should be of such a strength that the proportion of the test liquor used for washing the sample will be sufficient to dissolve the whole of the inverted and uncrystallised sugars present.

Alcohol, at the higher strengths, has a very limited solvent power for sugar; but its power for dissolving the sugar increases in a greater ratio than its reduction in strength. For example, at a temperature of 60° Fahr., 100 grains of alcohol by measure of the respective strengths of 62·6, 55·7, and 49·6 over proof dissolve 0·52, 1·34, and 2·94 grains of crystallised sugar respectively. It will thus be seen that, from 62·6 to 55·7 over proof, a reduction in strength of 6·9°, the solvent power of the alcohol is increased by only 0·82 of a grain, or 0·12 of a grain for each degree of reduction in strength, while from 55·7 to 49·6 over proof, a reduction in strength of 6·1°, the solvent alcohol is increased 1·60 grains, or 0·26 of a grain for each degree of reduction, being more than double the ratio of the increase from 62·6 to 55·7 over proof.

In like manner, the solvent power of alcohol for inverted sugar increases with its reduction in strength, but not in an increasing ratio, as in the case of crystallised sugar; on the contrary, the ratio of increase appears to be a diminishing one.

It is necessary to bear these facts in mind in select-

ing alcohol of the most suitable strength for preparing the test liquor. If the alcohol be of a very high strength, the result will show a higher percentage of crystallised sugar than is known to be present; but, on the other hand, if the alcohol used be of a very low strength, there will not only be considerable difficulty in fully saturating it with cane-sugar, but the result will be a much less proportion of crystallised sugar than there should be.

This may be illustrated by the following results obtained from experiments, made upon the same mixture of refined sugar and treacle, with test liquors prepared from alcohol at each of the strengths specified.

	Percentage of crystallised sugar.
1. Alcohol of 40 over proof gave	49·20
2. " 56 " "	54·49
3. " 63 " "	64·70

The result obtained in No. 2, by alcohol of 56 over proof strength, is within a few tenths of the quantity of crystallised sugar known to be present. The large excess in No. 3 is doubtless due to the very limited solubility of inverted and uncrystallised sugars in alcohol of that strength, and the consequent difficulty of dissolving the whole of these sugars in a given number of washings, and thus liberating the crystallised portion. In No. 1 there is a considerable deficiency, which is probably due to the water in the sample having increased the solvent power of the alcohol at that strength in a greater ratio than in the other cases at the higher strengths. The additional quantity of crysr tallised sugar, however, which the reduced test liquo-dissolves, is not, as a rule, in proportion to the reduction which the quantity of moisture in the sugar would make in the strength of the alcohol, a circumstance which is due to the fact that the time the test liquor and the sugar are in contact is too short to allow the former to become completely saturated.

After making a variety of experiments, it soon became obvious that the most suitable strength of alcohol to be used for preparing the test liquor lay between 50 and 56 over proof; but that it could not be absolutely affirmed that alcohol of any particular strength was applicable to the analysis of all description of sugar, ranging from the finer qualities down to molasses.

To ascertain the relative value of alcohol at the strengths of 56 and 50 over proof for preparing the test liquor, a mixture was made, consisting of 60 parts of purified white sugar and 40 parts of treacle; and experiments were made on the mixture with saturated alcohol at each of the strengths named, with the following results:—

	Percentage of crystallised sugar.
Alcohol of 56 over proof gave	59 12
" " 50 " "	57·72

Thus, with alcohol of a strength of 56 over proof, there was a loss of 0·88 of crystallised sugar; but, with the alcohol of 50 over proof, the loss amounted to 2·28 grains, or nearly 2½ per cent more than in the case of the alcohol of the higher strength.

The test in this case was very rigid, and, upon this ground, as well as from a slight loss which must inevitably occur in manipulation, the loss of the 0·88 of crystallised sugar with the alcohol of 56 over proof strength may be accounted for. With refined sugar, it is not only difficult to obtain an intimate and uniform mixture of the crushed crystals and treacle, but the crystals remain exposed, as it were, to the immediate action of the first portion of the test liquor, which acquires increased solvent power from the additional moisture which it takes up from the sugar.

The sample of treacle employed in the preparation of the mixture was found to contain 3·35 per cent of salts and other impurities insoluble in the test liquors; and, in calculating the results, an allowance was made for the proportion of insoluble matter contained in the quantity of treacle used in the experiments.

To determine whether a test liquor prepared from alcohol of a strength of 56 over proof would give uniform results with mixtures of crystallised and inverted sugars in all proportions, mixtures were made of treacle and raw sugar, varying from 10 to 90 per cent of each; and the several mixtures were submitted to careful analysis, and the same conditions observed in every instance. Three analyses were made of each mixture, and also of the raw sugar, and a mean of the results taken.

The raw sugar used was of medium quality, and gave 84·69 per cent of crystallised sugar. The treacle employed was the same as that used in the experiments referred to above; and, in each instance, the proper allowance was made for the proportion of salts and other impurities insoluble in the test liquor.

The mean results of the analyses made of the respective mixtures were as follows:—

					Percentage of crystallised sugar by calculation.	Percentage of crystallised sugar by experiment.	Loss.
90 parts of sugar	and	10	of	treacle	76·22	75·80	0·42
							Gain.
80 "	"	20	"		67·75	67 84	0 09
70 "	"	30	"		59·21	59·71	0·43
60 "	"	40	"		50·81	51·44	0·63
50 "	"	50	"		42·34	43·65	1·31
40 "	"	60	"		33·87	36·01	2·14
30 "	"	70	"		25·40	28·01	2 61

From the results of the experiments, it will be seen that, as the percentage of treacle is increased (the percentage of moisture being also thereby proportionately increased), the residue, contrary to what might have been expected, indicates a small but gradually-increasing excess over the percentage of crystallised sugar known to be present. This cannot be due to the salts and other impurities in the treacle which are insoluble in the test liquor, for they, as before stated, have already been allowed for. It is highly probable that it is caused by the increasing viscidity of the mixtures and the consequent difficulty of the alcohol, limited in quantity, and approaching nearer and nearer to its saturating point for inverted and crystallised sugars, in effecting the liberation of the crystallised portion.

The results obtained in the analysis of the mixtures containing 80 and 90 per cent of treacle respectively were considerably in excess of the quantity of crystallised sugar present; and it was obvious that the test liquor was inapplicable to the analysis of mixtures containing so large proportions of treacle.

The results accord very well with the theoretical percentages of crystallised sugar in the mixtures down to 50 per cent, but, from this point, the results are not so satisfactory as could be wished.

In the analysis of samples of sugar or mixtures of

sugar and treacle in which the proportion of inverted and uncrystallised sugars amounts to upwards of 50 per cent, a test liquor prepared with alcohol of a slightly lower strength than 56 over proof is more suitable, and gives more accurate results; in fact, by gradually reducing the strength of the alcohol, and employing a fresh test liquor as the scale is descended, practically accurate results may be obtained down to the lowest mixture, consisting of 90 parts of treacle to 10 of sugar.

The mode in which the analyses were conducted may be shortly described. To alcohol of the proper strength, excess of finely-powdered purified white sugar was added, and the mixture was agitated for two or three days, and, as required for use, the clear saturated liquid was drawn off. 100 grains of the sample were then gently rubbed in a mortar with 200 fluid grains of the saturated alcohol, and the washings thrown upon a filter previously counterpoised with another filter. The operation of washing was repeated nine times, with the like quantity of fluid grains, the sugar in the mortar being gradually transferred to the filter, so that, when the 2000 grains of the test liquor were used, the whole of the sugar had been transferred to the filter. The counterpoised filter and that containing the crystallised sugar were then dried in a water-bath, and the difference in the weights, after allowing for the salts, &c., present in the treacle, and insoluble in the test-liquor, gave the percentage of crystallised sugar in the sample.

My best thanks are due to Messrs. Helm and Stokes for the valuable assistance which they rendered me in making the experiments connected with this investigation.

ON THE ACETIC DERIVATIVES OF HYDROCARBONACEOUS SUBSTANCES.

BY MM. SCHUTZENBERGER AND NAUDIN.

Acetic anhydride reacts easily upon many immediate organic principles, playing the part of polyatomic alcohols. The total transformation of bodies into acetic derivatives is thus quickly effected, the degree of substitution varying according to the temperature and the quantity of the anhydride. Here are the results of my experiments.

Acetic Celluloses.—The cellulose (Swedish paper or cotton) was heated to 180° in a closed vessel with six or eight times its weight of acetic anhydride. It dissolved into a thick syrup, which, when poured into water, precipitated white flakes of triacetic cellulose—

$$C_6H_7(C_2H_3O)_3O_5,$$

insoluble in water, alcohol, or ether; soluble in concentrated acetic acid; easily saponifiable by alkalies, with regeneration of cellulose. Whatever the duration of the heating process or the excess of anhydride employed, no higher limit was reached. Cellulose is, then, a triatomic alcohol—

$$\left.\begin{matrix} C_6H_7O_2 \\ H_3 \end{matrix}\right\} O_3.$$

On employing but two parts of anhydride, and heating to only 150°, the cotton swelled without dissolving, by reason of the simultaneous production of diacetic and monoacetic ethers, which could not be separated.

Starch and Dextrine.—Starch, when heated to 140° with excess of acetic anhydride, swelled greatly without dissolving. The mass, when washed with water, yielded a white, amorphous substance insoluble in water, alcohol, ether, and acetic acid; not turned blue by iodine, and saponifiable by caustic alkalies, with regeneration of starch, turning blue by iodine. It represents triacetic starch $C_6H_7(C_2H_3O)_3O_5$. If the mixture of starch and acetic acid be heated to 160°, the swelled mass will dissolve, yielding an amber syrup. This, when poured into water, precipitates a white, amorphous matter, insoluble in water, alcohol, and ether, but soluble in glacial acetic acid. It is easily saponified by alkalies, with separation of dextrine. Its composition is the same as the preceding, and represents triacetic dextrine obtained directly by the action of the anhydride upon dextrine. The degree of substitution of the third order cannot be passed; those inferior were not examined, on account of the difficulty of distinguishing them. Starch and dextrine act, therefore, as triatomic alcohols.

Glycogene.—Glycogene, when heated at 155° with excess of acetic acid, swells without dissolving. The mass, washed in water, gives an amorphous, white product, insoluble in water (even warm), and in alcohol, ether, and acetic acid. It is saponified by alkalies, with regeneration of glycogene. It represents the maximum of saturation, and is triatomic—$C_6H_7(C_2H_3O)_3O_5$.

Gum Arabic.—This substance, when heated with about two parts of acetic anhydride to 150° for some hours, swells without dissolving. The mass, washed first with boiling water and then with alcohol, leaves an amorphous white powder, insoluble in boiling water, and saponified by alkalies, with regeneration of soluble arabin. It represents diacetic arabin, $C_6H_8(C_2H_3O)_2O_5$. By employing an excess of 6 to 8 parts of acetic anhydride, and heating to 180° for five or six hours, a triacetic derivative is obtained, similar in its properties to the preceding one: this is the highest degree of substitution.

Inuline.—This yields, under the same conditions, a saturated, triacetic derivative, soluble in water, of a bitter taste, and melting, at about 110°, into a syrup which solidifies into a vitreous, transparent, and colourless mass. It is easily saponified by alkalies, with regeneration of a white body, insoluble in water, and which melts below 100°. Thus, cellulose and its isomers of the formula $C_6H_{10}O_5$ all give saturated derivatives of the third degree, easily distinguishable from each other by their character of solubility and the nature of the products generated by saponification.

Acetic Derivatives of Sugar.—The action of acetic anhydride on sugar is vigorous: the reaction begins at the instant when the acid boils, and ends of its own accord in a few moments, with great development of heat. The sugar was heated for twenty-four hours at 170° with large excess of anhydride. Alkalies could not here be used for decomposition on account of their ulterior action upon sugar, but it was easily effected by water only at 160°.

Acetic Glucose.—One part of dry glucose, heated to the boiling point of the acetic anhydride with 2½ parts of the latter, in an open vessel, gives a lively reaction, ending in a few moments. The product, when suitably purified, is solid, colourless, and of a bitter taste. It is soluble in water, alcohol, ether, and acetic acid, and melts below 100°. Its analysis corresponds with the formula for diacetic glucose, $C_6H_{10}(C_2H_3O)_2O_6$. This substance, when again heated to 140° with about twice its weight of anhydride, yields a second solid derivative, distinguished from the first by its slight solubility in pure water. It dissolves in water containing acetic

acid, in alcohol, and ether, and represents triacetic glucose. This latter, maintained at 160° for twenty-four hours with a large excess of anhydride, changes into a saturated product very similar to the preceding, but differing by its insolubility in water charged with acetic acid. The acetic liquid, poured into water, yields a viscous precipitate, which is washed with water, again dissolved in alcohol containing bone-black, filtered, and evaporated to dryness. Its composition, which is ascertained by combustion and estimation of the acetyle, is that of tetracetic glucose, wanting a demi-molecule of water, and answers to the formula $C_{12}H_{14}(C_2H_2O)_8O_{11}$. The more simple formula, $C_6H_8(C_2H_3O)_4O_5$, may, perhaps, be employed, but it does not tally so well with the results of the analysis. Under these conditions, glucose undergoes a partial dehydratation. Cane-sugar yields, under similar circumstances, a saturated derivative, undistinguished in character or composition from the preceding. (The rotatory power was not studied.)

Lactine, heated to 140° with acetic acid, dissolves entirely. The liquid, when poured into water, yields a viscous precipitate, which quickly becomes powdery. Acetic lactine softens at about 52°; its composition corresponds with the formula $C_{12}H_{14}(C_2H_2O)_8O_{11}$, or $C_6H_8(C_2H_3O)_4O_5$.—*Comptes Rendus.*

ON THE

OXIDATION OF PHOSPHORUS

AND THE

QUANTITY OF PHOSPHORIC ACID EXCRETED BY THE KIDNEYS IN CONNECTION WITH ATMOSPHERIC CONDITIONS.*

BY J. MOFFAT, M.D., F.R.A.S., F.G.S.

FROM results deduced from observations on the luminosity of phosphorus in connection with atmospheric conditions for a period of six years, it appears that periods of phosphorescence and ozone periods commence, continue, and terminate under the same atmospheric conditions; that phosphoric ozone is formed only when phosphorus is luminous, and that increase of temperature and low atmospheric pressure are favourable to luminosity, while low temperature and high atmospheric pressure are unfavourable to it.

While the readings of the barometer are increasing and the wind is veering towards the N. points of the compass, phosphorescence diminishes in brilliancy and ozone in quantity; and, while the polar current continues, the barometer attains its maximum, the wind veers from N. to E., phosphorus becomes non-luminous, and ozone disappears. If, when the wind has veered to the E., the barometer readings begin to decrease, the wind sets in from points by S., phosphorus becomes luminous, and ozone appears; and, while the south or equatorial current continues, the barometer readings fall to a minimum, the wind veers from S. to W. points, phosphorescence becomes brilliant, and ozone is in maximum quantity. Liquid and gaseous bodies, when in contact with phosphorus in a non-luminous state, become phosphorated, and they, under suitable conditions, become phosphorescent and ozonised, the temperature at which phosphorescence takes place varying with the pressure of the atmosphere.

As venous blood contains phosphorus (phosphorated fat), which, in coming in contact with the oxygen of the air during respiration, is converted into phosphoric acid (the blood, perhaps, being ozonised at the same time), and combines with the alkalies and earths in the *liquor sanguinis*, and forms phosphates of soda, magnesia, and lime, it appeared to me not unreasonable to suppose that the quantity of phosphorus oxidated and phosphates formed in the system, and eliminated from it through the kidneys, is in some degree determined by the pressure and temperature of the atmosphere, and the state of the weather generally.

With a view to ascertain the quantity of phosphoric acid excreted by the kidneys, I tested the urine of a healthy man daily for twelve months. The quantity of urine evacuated in twenty-four hours was measured daily, and the quantity of phosphoric acid in one ounce of it ascertained. The man was of abstemious habits; his food seldom varied in kind or quantity. It consisted of tea, bread-and-butter, eggs, animal food, rice, oatmeal, and milk. The two articles in excess were bread and milk; of the latter he took at least 3 pints daily. The readings of the barometer and thermometer, the quantity of atmospheric ozone, and the direction of the wind, were recorded daily. The results were deduced monthly, and tabulated as below.

TABLE I.

Showing the Mean Daily Quantity of Phosphoric Acid Excreted by the Kidneys when—

The barometer was					Temperature was		Ozone was		Phosphorus was		The wind was			
Increasing.	Decreasing.	Above 30 in.	Above 29 in., below 30 in.	Above 28 in., below 29 in.	Increasing.	Decreasing.	Present.	Absent.	Luminous.	Non-luminous.	N. to E.	E. to S.	S. to W.	W. to N.
grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.
58·8	62·8	53·6	57·5	67·5	62·4	61·4	62·0	56·0	60·0	57·0	56·8	59·5	62·0	61·4

From these results, then, it would appear that the maximum quantity of phosphoric acid excreted from, and in all probability formed in, the system occurs with the conditions of the equatorial or south and ozoniferous current of the atmosphere, and that the minimum quantity occurs with the conditions of the polar or north and non-ozoniferous current. The results of the observations for each month were similar to those in the table, with the exception of March and May. In March, there were 2 grains more of daily mean with increasing than with decreasing readings of the barometer; and, in May, the quantities were equal for both sets of readings. The range of the barometer, for March and May, was 1·247 in. only; while, for August and November, the range was 1·532 in.; and the difference in the quantities of phosphoric acid excreted was a daily mean of 12 grains more with decreasing than increasing readings. When the range of the barometer for the month is above 1·5 in., the difference in the two sets of readings is 6·8 grains more with decreasing than increasing readings; and, when the range is less than 1·5 in., the mean difference between the two sets of readings is 3·4 grains more only for decreasing than increasing readings.

During the months from October to February (both inclusive), that is, during the months in which the temperature of the air is owing more to atmospheric than solar influence, a piece of phosphorus was kept in a dark cellar. It was examined daily, and the quantity

* Read before the British Association, Exeter Meeting, Section B.

consumed or oxidised was ascertained monthly. The results are given in the following table:—

Table II.

Showing that, when the Mean Monthly Reading of the Barometer was—

Between	The quantity of phosphorus oxidised was	The mean daily quantity of ozone was	The No. of azone days was	The mean daily quantity of phosphoric acid excreted was
in.	grs.			grs.
29·0 and 29·5	41·3	2	18	62·5
29·5 " 30·0	20 0	1	8	55·6

From this, it would appear that the amount of phosphorus oxidised in the air and the amount oxidised within us depends upon similar atmospheric conditions. The readings of the barometer which lead to the issuing of cautionary (Admiral Fitzroy's) telegrams are, of course, decreasing.

I have observed that 94 per cent of the telegrams are accompanied by the commencement of periods of phosphorescence. Atmospheric ozone invariably appears or increases in quantity with them. The mean daily quantity of phosphoric acid excreted by the kidneys on the day before the telegrams is 65·3 grains; and, on the day of it, 63·9 grains; giving a mean of 64·6 grains, which is 3½ grains daily above the mean.

The diseases which accompany the meteorological changes which appear to lead to the foregoing results I leave for future discussion.

Hawarden, July, 1869.

ON THE

SOLVENT TREATMENT OF URIC ACID CALCULUS

AND THE

QUANTITATIVE DETERMINATION OF URIC ACID IN URINE. *

BY THE REV. W. V. HARCOURT.

When the British Association met at Manchester in 1861, Dr. Roberts, Physician to the Royal Infirmary of that city, communicated a paper respecting "The Power of Strong and Weak Solutions of the Alkaline Carbonates on Uric Acid Calculi," † in which he showed the fallacy of the experiments supposed to have proved their inefficacy in a report formerly made to the French Academy by MM. Gay Lussac and Pelouze.

Dr. Roberts found that solutions of the carbonated alkalies containing more than 120 grains of the salt in a pint of water arrested their own action by forming an insoluble crust of biurate on the calculus, and that the maximum of solvent power lay in solutions which contain 50 or 60 grains in the pint. At this strength, no incrustation was formed when the carbonate of potash was employed; and 21·4 grains per cent of the weight of the calculus were removed by a flow over it of 6 pints in twenty-four hours. The carbonate of soda followed the same general course, with inferior efficacy.

In 1865, Dr. Roberts communicated to the Royal Medical and Chirurgical Society of London‡ a paper in which he showed, by a series of well-devised experiments, how this discovery might be applied, with a reasonable prospect of advantage, to medical practice; and laid, for the first time, a scientific basis for attempts hitherto empirical and contradictory at dissolving the stone. The most remarkable of these experiments was that in which he passed the urine of a patient who was taking citrate of potash at the rate of 40 grains in 5 ounces of water every two hours over a fragment of uric calculus, and, by this process, reduced it in twelve hours from 180·5 to 174 grains, or at the rate, in twenty-four hours, of 13 grains.

In July, 1868, I was made aware, by an eminent surgeon, Mr. Spencer Wells, of the presence of a stone in the bladder, one diameter of which appeared to measure 1½ inches; and I was advised by Mr. Wells (and by Sir H. Thompson, who confirmed his opinion as to the size of the stone), to aim at preventing its enlargement by such doses of citrate of potash as might keep the urine in a state approaching neutrality. In conversation with my excellent friend, the late Mr. Hodgson, who, when surgeon to the Birmingham Hospital, had had great experience in this complaint, I learned that he had met with so much success in the application of an empirical medicine of much celebrity, manufactured in that neighbourhood, and consisting of carbonates of potash, that, in any case of uric acid calculus, he would advise the experiment of its administration.

Mr. Wells afterwards drew my attention to the experiments of Dr. Roberts, which appeared so satisfactory that I determined to make trial of his method of treatment, and to ascertain, if possible, by chemical analysis, the excess of uric acid above the normal quantity contained in the urine which it might be considered as removing from the calculus.

I felt the great importance of the inquiry, and had the advantage of more than ordinary leisure, a long familiarity with chemistry, a well-furnished laboratory, and an assistant in executing the experiments on whose accuracy I could fully rely.*

I will now proceed to lay before the Section a short abstract of the chief results which I have obtained from an unintermitted course of careful experiments on all the urine voided during the past twelve months, some of which will be found of value to future experimenters, though, from causes which I shall describe, they have not realised all my expectations. If, as I had supposed, there had been any known chemical method of determining, with a near approach to accuracy, the amount of uric acid in urine, then the quantities of that acid which Dr. Roberts had found to be removed from calculi out of the body were abundantly sufficient to be ascertained by analysis, on the supposition that the same process went on in the bladder under the treatment recommended by him. I had scarcely, however, commenced my course of experiments before I became convinced of the fallibility of the methods in use for separating uric acid; and the experiments which I have to describe will place that fallibility in a strong point of view.

The method first employed was the ordinary one of adding 5 per cent of hydrochloric acid, allowing the mixture to stand forty-eight hours, and then, after decantation, collecting the uric acid on a small filter, washing it with distilled water, and drying it at 212° F. till it ceased to lose weight. The first seven determinations, from the 20th of August, 1868, to the 26th, inclusive, were made each day on the urine of the preceding

* Read before the British Association, Exeter meeting, Section B.
† "Report of the British Association, Manchester, 1861," p. 90.
‡ *Medico-Chirurgical Transactions*, vol. xlviii., p. 89.

* My assistant, Mr. W. P. Horn, learned, in Sir Benjamin Brodie's School of Chemistry, in Oxford, those habits of precision in manipulating and accuracy in observing which are essential to chemical experiments.

twenty-four hours, in a neutral or slightly alkaline state, brought to that state by doses of from 120 to 165 grains of citrate of potash. The quantities of uric acid obtained varied from 11·08 to 8·43 grains. In the subsequent daily determinations, down to the 5th of September, acid reactions were interpolated, due to the use of smaller alkaline doses, which lowered, proportionably, the amount of uric acid obtained; and, when no alkali had been taken for two days, and the urine was, in consequence, strongly acid, the quantity of uric acid found was only 2·35 grains.

From this time commenced a course of large quantities of citrate of potash, amounting, during fourteen days, to 315 grains in twenty-four hours, taken in a state of effervescence, in doses of 45 grains, dissolved in 3 fluid ounces of water. For ten of these days, the hydrochloric acid was used to precipitate the uric acid; and the determination of this gave from 11·95 to 6·00 grains. In every case but the last, the whole urine of the twenty-four hours had been used; but, in the last, half was treated with hydrochloric acid, and the other half with the same proportion of nitric acid: that treated with the former acid gave 6·42 grains, whilst that with the nitric acid gave only 1·97 grains. On the following day, half the urine was treated by Lehmann's process, and gave 6·40 grains; half with nitric acid and acetic acid, in equal proportions, which gave 4·09 grains uric acid. The preference, however, assigned by Dr. Thudichum, in his able and well-known treatise on the "Pathology of the Urine," to nitric over hydrochloric acid as having given him better results led me to continue its use.

The quantity of citrate of potash taken was then raised to 350 grains for four consecutive days. On the first of these days, the uric acid found was 1·54 grains; on the second, 1·23 grains. These results were so extraordinary that, for the purpose of corroborating them, or discovering an error in the analysis, I sent 40 fluid ounces out of 61 fluid ounces voided on the latter day to Dr. Thudichum, who was so good as to furnish me with his analysis of it, containing the weights of sulphuric acid, phosphoric acid, chlorine, potash, urea, and uric acid which he had obtained. The uric acid amounted to no more than 0·775 grains.

This result led to one of two conclusions. Either independently of any question of the solution of the calculus the presence of uric acid in the bladder had been almost entirely prevented by the alkaline treatment, or the process for obtaining it was altogether unreliable. Taking the latter alternative as far the more probable, I endeavoured henceforward to improve the analysis. The mucus secreted from the bladder by the alkaline action being now a good deal in excess, I was advised that it would be prudent to diminish the quantity of alkali taken; and it was accordingly reduced, for five days, to 300 grains of the citrate, and, for eight days, to quantities varying from 270 to 240 grains. The alkalinity was now determined for every voiding with hydrochloric acid. 2·5 per cent of that acid was added to each; and, as it had been observed that uric acid was lost by decantation, however careful, the portions of urine operated upon were entirely filtered, and the water with which the precipitates were washed was acidified with acetic acid. Under this treatment, on the fifth day of taking 300 grains of citrate, the alkalinity, measured by a standard solution of hydrochloric acid, and estimated in grains of carbonate of potash, was 25·5 grains per pint. The uric acid obtained weighed 4·74 grains; and the series below 300 grains of citrate gave quantities of uric acid varying from 2·91 grains, the alkalinity being 23·05 grains per pint, to 8·42 grains, the alkalinity being 17·2 grains per pint.

One-half of that which, with 2·5 per cent hydrochloric acid, had yielded 8·42 grains was treated with 5 per cent nitric acid, and kept at the temperature of 90° F.; and, to render the experiment analogous to Dr. Thudichum's analysis, the alkalinity and dilution were brought to a similar standard by additions of carbonate of potash and water. The uric acid thus obtained weighed 2·07 grains, showing a loss, by this method, of 6·35 grains.

The following table contains an account of the uric acid obtained on the thirty-five days from October 9th to November 12th, inclusive, as well as of the potash taken, and the quantity and alkalinity of the urine:—

Citrate of Potash.	Alkali, per pint.	Uric acid.	Urine voided, in ounces.
220	16·3	6·9	51·4
20	16·8	5·6	46·6
10	22·1	8·1	40·6
255	4·2	12·2	49·7
240	19·1	7·9	47·1
240	21·3	10·6	50·7
240	30·9	9·3	55·1
225	20·0	8·4	51·9
260	36·2	6·4	46·4
270	19·5	5·5	59·0
230	18·4	6·5	56·5
240	16·8	9·1	60·7
270	22 6	7·1	53·5
270	29·0	6·6	63 5
255	27·5	8·4	59·7
285	35·4	3·23	62·5
255	40·3	7·1	52·0
240	29·4	9·6	52·0
240	19·8	8·8	52·9
225	23·3	8·7	60·3
140	10·0	11·9	64·7
140	5·0	5·1	57·2
120	1·4	4·9	44·0
120	4·2	6·4	45·0
25	5·2	7·8	51·5
185	7·6	8·4	52·5
225	26·3	7·3	51·5
210	17·4	9·7	61·9
210	22·0	7·3	64·5
210	16·4	8·3	76·4
210	19·2	8·5	42·5
210	19·5	9·4	51·4
210	19·8	9·9	63 5
195	21·3	7·6	53·5
180	21·2	11·6	55·5

In this table, the highest quantity of uric acid, 12·2 grains, is connected with an alkalinity of 4·2, while the lowest quantity, 3·2, was obtained when the alkalinity was as high as 35·4. Twenty days, in which the alkalinity of twenty-four hours varied from 19·2 to 40·3 gave an average of 7·94 grains; whilst fifteen days, when the alkalinity was from 19·1 down to 1·4, gave an average of 8·08 grains. These data would lead to the supposition that the alkali had exercised no action on the calculus; but, on the other hand, the great and sudden rise of the uric acid, when the alkalinity descended from 22·1 to 4·2, might raise a suspicion that the alkaline treatment may reduce the secretion of uric acid, and, in that case, the absence of solvent action cannot be inferred.

A good deal of blood passed with the urine from the 13th to the 16th of November, accompanied with some

diarrhœa and sickness. On the 17th, the determination of the uric acid was resumed; the alkalinity on that day being 5·3; the uric acid was 11·55 grains. On the following day, the acidity being 10·8, the uric acid was 10·38 grains.

I now instituted some new experiments, on the effect which different degrees of dilution in urine produce on the separation of uric acid. On November 19th, 40 grains of citrate of potash having been taken, the urine voided in twenty-four hours amounted to 31 fluid ounces; it was neutral; the sp. gr. was 1·032. It was divided into three equal portions, one-third in the natural condition treated in the usual manner with 2·5 per cent. Hydrochloric acid gave uric acid at the rate, for twenty-four hours, of 11·78 grains; one-third, diluted with its own bulk of water, and of sp. gr. 1·022, treated in like manner, gave uric acid 10·99 grains; one-third, evaporated down to half its bulk, and then heated with the same quantity of hydrochloric acid, gave, uric acid, 13·81 grains. November 22nd. 180 grains of citrate having been taken, the alkalinity being 1·96, and the sp. gr. 1·030, the urine for the twenty-four hours, amounting to 41·5 fluid ounces, was divided into two portions, one of which, in the natural condition, gave 12·32 grains; the other, concentrated to one-third, sp. gr. 1·070, gave 14·78 grains of uric acid. On the 23rd, the same quantity of citrate being taken, the alkalinity, 18·05, sp. gr. 1·028, the quantity of urine, 42 fluid ounces, one-half in the natural condition, gave 12·72; the other half, concentrated to one-fourth, sp. gr. 1·072, gave 14·94 grains of uric acid. On the 24th, the same quantity of citrate being taken, the alkalinity, 20·4, sp. gr. 1·030, the quantity of urine, 35 fluid ounces; one-half, in the natural condition, gave 10·318; the other half, concentrated to one-fourth, sp. gr. 1·074, gave 12·135 grains of uric acid. On the 25th, the same quantity of citrate being taken, the alkalinity, 21·2, sp. gr. 1·031, the quantity of urine, 43 fluid ounces; one-half, in the natural condition, gave 9·94 grains; the other half, concentrated to one-fourth, sp. gr. 1·075, gave 11·02 grains of uric acid. Again, on the 30th, 135 grains of citrate having been taken, the alkalinity, 37·6 the quantity of urine, 40 fluid ounces; one-half, in the natural condition, gave 8·53; the other half, concentrated to one-third its bulk, gave 12·66 grains of uric acid.

These give very nearly the two extremes of difference in forty comparative experiments, in the last fifteen of which the urine was reduced to a standard volume of 6 or 3 fluid ounces, according as half or quarter of the urine was employed; the average difference in these fifteen was 3·03, and in the former twenty-five, reduced to the proportions above described, 3.09 grains. What was the cause of the variation in the differences does not appear; it occurred equally, whether the urine was acid or considerably alkaline.

It follows, I think, from these experiments, that, to any average quantity of uric acid obtained from an unconcentrated urine, 3 grains may be added; and the last experiment described in this paper makes it probable that the employment of a better method of analysis may increase this augmentation.

I was not satisfied, however, that sufficient accuracy of analysis had yet been obtained, and I have since employed the following process, which promises more perfect results:—A fourth of the urine of twenty-four hours is evaporated to 3 fluid ounces; it is treated with a mixture of hydrochloric acid and alcohol in equal parts, each being 2·5 per cent of the quantity of urine employed; it is allowed to stand for forty-eight hours, drained on a small filter, washed with alcohol (methylated spirits), and then with equal parts of acetic acid and water. The colouring matter and phosphates, &c., are thus removed, and the uric acid is of a light colour and perfectly, though confusedly, crystalline.

The advantage which this method possesses over those heretofore in use is shown in the experiment which follows:—In urine having an acidity of 5 grains per pint, the nitric acid method of Dr. Thudichum gave 1·16 grains of impure uric acid; the ordinary hydrochloric acid method gave 5·53 grains; the method above described gave 9·90 grains of uric acid. I have found this method equally effective in the treatment of acid urine neutralized by potash, and am inclined to believe that it might be not less applicable to that which contains a greater amount of chloride of potassium.

On the whole, these experiments, though they have failed to realize my expectation of testing, by analysis, the effect of Dr. Roberts's solvent treatment on vesical calculus, may serve to point out to others the road to success in such an attempt; and if they do so, the labour of a twelvemonth will not have been spent in vain.

There is one prominent chemical fact attending these experiments which remains to be noticed—viz., the greater amount of uric acid obtained before the alkaline treatment commenced, than in the last experiment by the same process, in the proportion of 9·56 to 5·53 grains. A similar diminution has taken place in the mineral acids; whilst from 120 to 150 grains of citrate of potash were required for neutrality in August, 1868, in March and April, 1869, from 30 to 60 grains sufficed for the same purpose. Dr. Thudichum's analysis, in September, 1868, gave, of sulphuric acid, 51·1 grains, of phosphoric, 45·7 grains. The analysis made in my laboratory, in March, 1869, gave—sulphuric acid, 25·9, of phosphoric, 34·2 grains, a difference scarcely to be accounted for without reference to the alkaline treatment undergone in the first three months of the interval.

Though I have been unable to produce any *chemical* evidence in favour of the solvent treatment, a fact observed during the whole course of that treatment, and not afterwards, persuades me that a solvent action was really going on. This fact consisted in a small amount of constant deposit, in which fragmentary particles of uric acid were discerned by the microscope, enveloped in mucus, and bearing, in the opinion of Mr. Wells, as well as my assistant, a close resemblance to the detritus left by the incomplete action of carbonate of potash on fragments of uric acid calculi. I suppose these to have been washed out of the bladder in consequence of a partial solution. That no such solution should have been brought into evidence by the many determinations of uric acid, however imperfect, which I have here described, if it cannot be fully accounted for by that imperfection, may possibly be due to a physiological effect of the alkaline treatment in preventing the formation of uric acid, which may have counterbalanced the excess expected from solution of the calculus. This point, a course of experiments which need not be very long, conducted by a process of analysis reliable within a tenth part of the weight of uric acid obtained, ought hereafter to determine.

My experience of the effect of doses of 300 grains of citrate of potash taken in twenty-four hours has convinced me that no disadvantage to health need be dreaded from such a course. I have not suffered so much from dyspepsia during the last twelvemonth as in

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many former years. Bleeding from the bladder has, indeed, supervened twice, but without any pain or irritation, and I have had no other symptom of the complaint; and this is the experience of a man of eighty years of age, who has been for some years an invalid.

P.S. I have omitted to state that the calculus was judged to be uric from the previous passage of crystals of uric acid. Since the alkaline treatment, the urine has been perfectly clear, free from all deposits. It was never ammoniacal when voided, and contained no albumen.

ON SOME REACTIONS OF CHLOROSULPHURIC ACID.*

BY JAMES DEWAR, F.R.S.E., AND GEORGE CRANSTON, EDINBURGH.

During the course of several experiments on the action of chlorosulphuric acid on phenol, we have noticed one or two decompositions with simple carbon compounds that may be of some interest. Since Kekulé's researches on the phenol sulpho-acids, chemists are agreed that, in these acids, the radical HSO_3 functions as a monadic group. It was but natural to expect that, if we substituted chlorosulphuric acid for sulphuric acid in forming these compounds, we should arrive at similar bodies, with this difference, that, in the one case, we should eliminate the hydrogen of the group acted on as water, and, in the other, as hydrochloric acid. Now, a critical examination of recent researches in the aromatic derivatives shows that certain groups or elements used as substituting agents tend to approach or separate, thereby producing isomeric compounds: for instance, Korner's celebrated synthesis of resorcine starts from dinitrobenzine, where the relative position of the two NO_2's is maintained throughout the number of complex compounds through which this chemist passed in order to replace the NO_2's by hydroxyls. But, if we examine the intermediate compounds produced, it is evident that, if we could change the conditions or modify the relations of the substituting groups, we might arrive at the same products by direct substitution. Thus the dinitrobenzine produced in the second stage of the before-mentioned synthesis might be made directly if we could form nitro compounds by some reagent other than nitric acid. The experience we possess at the present time is too meagre to admit of any attempted prediction of what would be the effect of substituting the same radical from different sources.

It was our intention to have investigated one reaction from this point of view, and we chose, for this purpose, an examination of the sulpho acid, or acids that would be produced by the action of chlorosulphuric acid on phenol, as compared with the sulpho acids produced when sulphuric acid is used. We were engaged in this direction when Engelhardt published his interesting paper bearing on this point. We have, however, noticed one or two reactions of this substance that may be acceptable at the present time.

The chlorosulphuric acid used in this investigation was prepared by the direct action of sulphuric acid on hydrochloric acid. We found the reaction to go with great ease and rapidity, the temperature of the sulphuric acid, containing a large percentage of sulphuric anhydride, rising to 120° C. The substance had all the properties ascribed to it by Williamson. In our first experiments, we attempted to prepare the acid by acting on sulphuric acid with pentachloride of phosphorus, as described by Williamson. We found it impossible to free the chlorosulphuric acid completely from oxychloride of phosphorus.

We attempted the formation of Kolbe's trichlormethylsulphurous acid by the action of chlorosulphuric acid on chloroform, expecting $CHCl_3 + Cl(HSO_3) = CCl_3(HSO_3)$. We found that, when equivalent quantities of chlorosulphuric acid and chloroform were heated in a sealed tube to 120° C., instead of obtaining Kolbe's acid, we got the decomposition products of this acid—sulphurous acid, hydrochloric acid, and chlorocarbonic acid, thus—$CCl_3(HSO_3) = CCl_2O + HCl + SO_2$. The pressure in the tubes being so enormous, we found them extremely liable to burst. No doubt tetrachloride of carbon would give a similar decomposition, with the difference that SO_2Cl_2 would be produced simultaneously. This reaction is interesting, as Schutzenberger has just shown the formation of phosgene gas by the action of sulphuric anhydride on tetrachloride of carbon.

We have examined, also, the action of chlorosulphuric acid on bisulphide of carbon. When equivalent quantities of chlorosulphuric acid and bisulphide of carbon were heated in a sealed tube to 100° C. for some hours, we found the non-miscible liquids changed into a clear, mobile liquid, from which had deposited large yellow crystals of sulphur. The tubes, when carefully opened, continued to evolve gas until the whole of the mobile liquid disappeared: the liquid was condensed sulphurous acid. The gas was collected over water, when a large quantity was rapidly absorbed. The gas not absorbed after it had stood for some time over water we have carefully examined, and found to have all the properties of oxysulphide of carbon. This reaction is interesting as showing the formation of oxysulphide of carbon by direct substitution of sulphur in bisulphide of carbon by oxygen. The reaction is evidently—

$$CSS + Cl(HSO_3) = CSO + HCl + SO_2.$$

Probably the reaction would succeed better by the action of sulphuric anhydride on bisulphide of carbon. In this case, the pressure in the tubes would be greatly diminished by evading the presence of the hydrochloric acid gas. Lautenberg has recently shown the formation of oxysulphide of carbon in many reactions; and this is another instance in which it is produced.

* Read before the British Association, Exeter meeting, Section B.

THE PREPARATION OF SESQUICHLORIDE OF CARBON.

BY H. BASSETT, ESQ.

The vapour of tetrachloride of carbon is passed moderately slowly through a glass tube about 30 inches long, kept at a moderate red heat. The end of the tube fits into a quilled receiver, provided with a tube to carry off the excess of chlorine. The liquid condensed is dark yellow, from the chlorine held in the solution, and consists of sesquichloride of carbon, C_2Cl_6, and the liquid chloride, C_2Cl_4, with unaltered tetrachloride. It also contains a very small quantity of the chloride C_6Cl_6.

On exposing this liquid to a good light, the excess of chlorine is absorbed by the C_2Cl_4. It is then distilled with a thermometer. When the temperature has risen to 150°—160°, the residue in the retort consists almost entirely of C_2Cl_6, retaining the trace of C_6Cl_6 and a little impurity, which gives it rather a dark colour. It is poured out into a dish, when it soon becomes solid, and

may be purified by crystallisation, or by distillation with the vapour of water. The distillate under 160° is then saturated with chlorine in a good light, when the whole of the C_2Cl_4 is converted into perfectly white C_2Cl_6, which is easily separated from the unaltered CCl_4 by distillation.

In this manner there would be no difficulty in preparing the sesquichloride in any quantity.

ON A VERY

CONVENIENT MÈTHOD OF ASCERTAINING THE CONSTITUTION OF FLAMES.

BY M. L. DUFOUR.

M. Dufour recommends the following process for demonstrating, for instance, that the flame of a candle is formed of a hollow cone, luminous on the outside only, and dark in the interior. For this purpose it is necessary to cut the flame; the most preferable method of doing this is by means of a sheet of water or air. The arrangement is as follows:—A caoutchouc tube has, at one of its extremities, a gas jet, such as is used for common gas flames; this jet has an almost semicircular slit of 0·4 m.m. in depth. The other end of the tube communicates with a reservoir of water placed at a convenient height. Upon a suitable pressure, the water flows out by the slit in the jet, producing a clear sheet capable of preserving, for a sufficient length of time, an invariable form and size. The slit is placed in such a manner that the sheet presents a horizontal surface; and this will easily cut the flame of a candle, showing a perfect section. The hot gases and carbonaceous particles are carried off by the water. On placing the eye above the hollow cone, the luminous wall, &c., can be distinctly seen. Sections may easily be made near the wick or near the point; nothing hinders observation, which may be prolonged at pleasure, and a lens may be used if desired. A flame of gas may be cut and examined in the same manner, but the current of gas must not be strong enough to traverse the sheet of water. If a current of air be caused to come out of the slit by bellows, an invisible sheet of air is formed which is, also, very convenient for making a section of flame. Close observation is quite possible; for the aërial current prevents the heated gases from reaching the eyes, and a lens may be used, as in the former case. The flame forms a cone, whose luminous walls are extremely thin, and their interior can be plainly seen. A platinum wire may be introduced across the section; and, on being plunged as far as the wick, it will remain unreddened in the dark interior of the cone.

A jet of gas issuing from a circular opening, of from 1 to 2 m.m. in diameter, may also be cut very conveniently by the sheet of air. It will be seen to consist of a cone whose walls are brilliant and extremely thin. Upon bringing the sheet of air close to the aperture whence the gas escapes, the flame will be divided at its base and will reappear a little higher. By this means, the entire length of the luminous cone, its thin walls, and their interior may be examined.

If a jet of gas produced by a fan-tail burner be cut, the luminous fan will be found to consist of two brilliant blades, between which there is a narrow obscure space. The blades are at a great distance apart, and the dark space is wider towards the end of the fan-tails; and, by assuming a suitable position, it is easy to see through the section of flame into the dark space which separates the brilliant walls, and at the end of this will be seen the slit by which the gas escapes.

Instead of throwing the sheet of air perpendicularly to the flame, M. Dufour thinks it better to throw it partly on one side, on such a plane as to make a slight angle with the axis of the conical flame, or with the plane of the fan-shaped flame. A lateral suction is then produced by the influence of the current, which draws the flame, and inclines it against the sheet of air, by which it is cut. By placing the sheet of air on a more or less inclined plane, and approaching or removing it from the base of the flame, the section is easily made at points more or less distant from that base.

The method described above may, of course, be applied to any kind of flame. M. Dufour suggests that it might be of service in the chemical analysis of flames. When a flame is cut by a sheet of water, the water draws off the gases of which it is composed. If the section be made with a sheet of air, it will be easy, by placing suction pipes throughout the length, and ending at fixed points in the interior of the cone, to collect the gases whose composition is desired to be ascertained.—*Les Mondes.*

THE ECONOMICAL PURIFICATION OF ZINC CONTAINING IRON.

BY W. H. CHANDLER.

In the galvanising of iron, the article to be galvanised, after being thoroughly cleansed, is dipped into a kettle of molten zinc, which forms an alloy with the iron at the surface of contact, and by repeating the dipping the thickness of the superimposed zinc may be increased at pleasure. In the prosecution of this manufacture, the zinc is held in large iron troughs or kettles, which are rapidly corroded in those portions nearest the fire. An alloy of zinc and iron is formed, to which also the articles, being galvanised, in some degree contribute. This alloy being heavier than the purer zinc, sinks to the bottom, and, from time to time, is removed by perforated ladles.

The composition of the alloy is of course somewhat variable, depending upon the temperature and fluidity of the zinc and the careful straining from the fluid metal. The two analyses here given were made by the writer a number of years since:—

Zinc	94·27	94·15
Iron	5·46	5·00
Lead	0·27	0·56
Tin	trace	0·29
	100·00	100·00

These samples were taken from a re-melting of a large quantity of the alloy, which is the only practicable method of obtaining a fair average specimen.

The quantity of this dross or refuse is quite considerable, amounting probably, in the United States, to several hundred tons per annum. Formerly it was sold for use in coarse brass castings, and to some extent it was re-distilled. At one establishment in Boston circular clay retorts, similar to those in use in the gas manufacture, were employed, the molten alloy being introduced through an inverted syphon in the iron

mouthpiece and the condensing tube, connected with the reverse end of the retort, dipping in a pot of molten zinc; thus all access of air to the interior of the retort was prevented, and little or no oxidation of the zinc occurred.

Several years since, a small lot of this refuse zinc was received at a metallurgical establishment in Massachusetts, in which the writer was employed as chemist, and, in experimenting upon it, one of the foremen of the establishment originated a method by which the zinc could be obtained quite free from iron. Finally, after re-building his furnaces and in various ways altering and modifying his manipulations, the samples of purified zinc being analysed after each alteration of the process, a good commercial article was obtained containing only one-tenth of one per cent of iron.

The process consists in melting the refuse in an iron kettle, raising the heat nearly to the point of volatilisation of the zinc, and then, by a proper regulation of the heat, cooling the mass slowly from the bottom, by means of a special arrangement of flues. An alloy of zinc and iron, containing a much larger percentage of iron than the original refuse, gradually forms, falls to the bottom of the kettle, and is removed by a perforated ladle, while the fluid metal is much purer. The quantity of alloy to be ladled out depends upon the impurity of the original refuse. The purified zinc and the concentrated impurity are melted in separate kettles, and each treated as in the first operation.

One more fusion and refrigeration of the purified zinc and the still more impure zinc, render the former a good commercial spelter and the latter too impure for further economic treatment.

This process is the reverse in its reactions from Pattison's process for desilverising silver-lead ores. In the latter case the purer lead crystallises from the more fluid lead and silver, whereas in the former, the more impure alloy separates from the purified zinc.

The residue from this process, which is sold for distillation, consists of hexagonal prismatic crystals of a fixed alloy of iron and zinc, loosely agglomerated together so as to crumble in the hand.

When the operation of refining is badly conducted, more or less zinc acts as a solder for the crystals. They are beautifully iridescent, exhibiting all the colours of the rainbow, owing to a surface oxidation. A number of specimens of various colours were selected for analysis and showed a composition of—

Zinc	90·50
Iron	9·50
	100·00

Upon fusing these crystals, which requires a high temperature, and cooling as before, a small percentage of purified zinc is obtained, and an alloy containing as much as 12½ per cent of iron. This is compact, somewhat brittle, and exhibits no evidences of crystallisation.

This last-mentioned fusion is not made in practice, as the great heat required for its accomplishment rapidly burns out the iron kettles.

By a similar process lead has been removed from zinc with great accuracy, the amount obtained closely approaching the quantity therein. From a lot of Silesian spelter was separated lead perfectly malleable, and containing scarcely a trace of zinc. The purification of the lead, obtained from the process of desilverisation of silver-lead by means of zinc, could undoubtedly be accomplished by a modification of this process.

A NEW AND ECONOMICAL METHOD

FOR EFFECTING THE

EXTRICATION AND CONDENSATION OF AMMONIA FROM GAS LIQUOR

FOR PURPOSES OF CHEAP CARRIAGE, AND FOR FACILITATING THE MANUFACTURE OF AMMONIACAL SALTS.*

BY FREDERICK BRABY, F.G.S.

It is but a very few years since that the various bye-products obtained from the manufacture of coal gas were not merely a drug in the market, but proved an absolute nuisance to the manufacturer and to the general public.

Coal tar was even burnt under the retorts, or was introduced therein for the production of gas; and gas liquor was commonly given away to any one whose ingenuity might enable him to turn it to a useful purpose.

But the progress of science in this, as in other cases, soon discovered applications where none were supposed to exist.

From coal tar are not only now obtained naphtha, benzol, carbolic acid, and other valuable derivatives, but also the brilliant and diversified colours of what are called aniline dyes are obtained from the same source. The ammoniacal liquor, too, to which, on the present occasion, I desire to be favoured with your attention, is now not only not given away in the Metropolitan and other districts, but, in certain localities, the greatest competition exists for its acquisition. It at present constitutes, in this country, the principal source of ammonia, and, consequently, of the ammoniacal salts, which are so usefully and so successfully applied in the arts, and more especially to agriculture. In London and its neighbourhood, the purchase of the residuary products of the various gas companies is eagerly sought after, and it is now considered a privilege to be allowed permission to tender for them for the term of one, two, or more years' supply. Practically, the tar and gas liquor trade is in the hands of a few parties jealously desiring to exclude outsiders, who thus find it extremely difficult and often absolutely impossible to obtain even a few thousand gallons.

The object of the present communication is to show how the demand for gas liquor which so far exceeds the means of actual supply can be met. It is to show, moreover, that by condensation and reduction of bulk for transport, small and remote gas works may be enabled to utilise and export their residual products at a profit; and above all, how, by the introduction of certain improvements, the quantity of ammonia, as produced and utilised from the manufacture of gas, may be practically increased from ten to fifty fold.

The strength of gas liquor is commonly specified in the various tenders as technically 6 oz. The prefix, denoting the number of ounces, refers to each gallon of the liquor, and does not signify the number of ounces of ammonia that are present, but the number of ounces of sulphuric acid which would be required to neutralise the ammonia. Consequently a butt of 108 gallons of 6-oz. liquor implies, by calculation, that 108 times 6 ozs. or 40 lbs. of sulphuric acid are required to saturate the whole quantity. Now it is found in practice that, if we divide the quantity of sulphuric acid required by 3, we shall get at the quantity of ammonia

* Read before the British Association, Exeter meeting, Section B.

actually present. This result closely agrees with theory, the equivalent of dry ammonia being 17, and that of monohydrated sulphuric acid (oil of vitriol) being 49; the proportion is very nearly 1 to 3. It follows, therefore, that, as 40 lbs. of sulphuric acid are required to saturate a butt of 6-oz. liquor, so one-third of this or little more than 13 lbs. of real ammonia are contained in this immense quantity of liquid and merchantable product, weighing as it does in the aggregate no less than 1107 lbs., or half a ton. On referring to the ordinary commercial standard, viz., of 6 ozs. to the gallon, 6 ozs. of sulphuric acid divided by 3 gives 2 ozs. of ammonia as the entire quantity present. Now a gallon of the gas liquor weighs 10 lbs. and, if the lbs. be multiplied by 16 to reduce them to ounces, we have a total of 160 ozs., containing only 2 ozs. of real ammonia or 1 oz. to 80 ozs. of water.

The result of this is, practically, to prohibit the transport of gas liquor over any but moderate distances, because, in its present form, for every ton of real ammonia carried by barge, tank-cart, or otherwise, no less than 80 tons of water must be carried for no other purpose but as a solvent. It must not be inferred, however, that the *whole* of these 80 tons of water is waste carriage. Ammonia in a free state cannot be conveniently carried, except when dissolved in a certain quantity of water. It would not be judicious to concentrate the ammonia to a higher degree than 0·900, since if, in course of carriage, it were subjected to any great degree of heat, the water at an elevated temperature would disengage some of the NH_3 held in solution, and such a disengagement of ammonia might be attended with dangerous results. A very useful and safe solution for all purposes of transit would be about one part by weight of ammonia to four parts of water; this would reduce the present cost of carriage for this important article to no less than twenty times, or, in other words, the transit of a certain quantity of ammonia over a certain distance costing now £20 would, if conveyed in the above concentrated form, be reduced to 20s. This scale of reduction would at once enable it to be carried by rail in petroleum or other barrels, or in tank-trucks, or otherwise, and would bring the numerous gas works which are scattered over the United Kingdom within economical transport of the centres of manufacturing industry, so that this important bye-product of gas-making might be utilised for the general good, and be not so extensively wasted as has been, and is now, frequently the case.

In order to effect this desirable object, I recently, in conjunction with Mr. Baggs, secured a patent for effecting the necessary concentration of ammonia by certain novel means, which promise in practice to prove far more rapid and economical than any hitherto employed. The process may be shortly described as follows:—To the common ammoniacal gas liquor a certain quantity of slaked lime is added. The liquor thus treated is placed in a capacious boiler or still containing from four to five thousand gallons. The whole is then heated and maintained at a temperature of from 100° to 200° F., the liquor being slowly but constantly stirred by means of an internal agitator, the spindle of which passes through a stuffing box in the end of the boiler. A powerful blast of air from a double-action force-pump, actuated by a small steam-engine or otherwise, is blown continuously through the liquor. The air enters by two long perforated pipes placed near the bottom of the boiler, and in its upward passage it is compelled to pass through a horizontal diaphragm drilled with numerous small holes. The result of this arrangement being that the air, in its ascent, is subdivided into innumerable small sheaves and bubbles, to each and all of which, in accordance with well-known and recognised laws, the ammonia attaches itself and is carried away with only a very small proportion of aqueous vapour. An exit pipe is fixed to the top of the boiler, so as to carry away the mixture of air and ammonia, and the extremity of this pipe dips into a supply of water contained in a cold and suitable receiver, where the ammonia is immediately absorbed, and the air, after thus effecting its removal in a separate state, escapes through the water and is permitted to pass off into the atmosphere. The condensers are generally arranged like a series of what are known as Woulfe's bottles, but for the purpose of obtaining great strength and purity, this arrangement may be superseded in the manner following.

The ammoniacal gas separated by the air is purified in a manner which will be afterwards described, and is then caused to pass into a vessel about three parts filled with broken lumps of pure block ice. From the well-known affinity of ammoniacal gas for cold water, the gas is arrested by the ice, which is rapidly liquefied, and a pure solution of ammonia of any required strength is obtained. It is advantageous to cool down the mixture of air and ammoniacal gas before it is allowed to enter the condenser; the air, after having parted with the ammonia which has been dissolved by the liquefied ice, passes off into the atmosphere as in the former instance. The finest Norwegian transparent block-ice may, in the height of summer, be obtained at the London Docks at 23s. per ton, and even less, according to the number of tons required, the supply being constantly maintained by the arrival of fresh ships. Or ice may be obtained by one of Siebe's refrigerating machines almost as cheaply as that which is imported.

This patent process for separating the ammonia by blowing air through gas liquor, when at an elevated temperature, is so much more rapid in the operation than the process of merely boiling the gas liquor as hitherto conducted that, with a very moderate-sized apparatus, several thousand gallons of gas liquor can be treated in a single day, and the ammoniacal produce of the largest works may be continuously converted into a concentrated and more portable form without trouble or delay. Even in the smallest works, consuming not more than from ten to fifty tons of coal a week, the bulk and weight of the gas liquor may be quickly reduced, and the result will be of such standard value that a still containing from 20 to 100 gallons would, probably, in such cases, answer every desired purpose, and would be found to be remunerative. In many instances the gas liquor might be heated and the power supplied, if desirable, from the waste heat of the retorts.

By the adoption of this improved process the present trade in crude ammonia may be expected to expand and to become of higher importance than it now is.

The comparatively limited supply which is now available restricts its application. The commercial advantages which would be derived from the many technical purposes to which it is applicable would be considerable, and manufacturers being enabled to obtain cheap supplies from distant sources, the total quantity utilised would be immensely increased.

When, instead of producing caustic ammonia it is

desired to manufacture ammoniacal salts, the ammoniacal gas in conjunction with the atmospheric air may be conducted into sulphuric or muriatic acid, or into a metallic or saline solution capable of appropriating the ammonia.

As the evaporative power of air increases with the absence of moisture therein, it is possible that, by drying the same artificially before introducing it into the liquor, it would take up a great quantity of ammonia. The removal of all moisture from air may be effected with comparatively little expense by the suction of the air required for the forcepump through sulphuric acid, and a close wooden box containing lumps of chalk. This method is well known in connection with other applications.

The blast of air may be hot or cold, and may be delivered in any manner adapted to increase and effect more intimate contact between the air and the liquid containing the ammonia.

By adopting what I call the atmospheric or blowing principle, nearly the whole of the ammonia can be liberated from the solution in which it is contained, without any fire or external heat applied to or under the still or boiler, but, if the liquor be heated, the solubility of the alkaline gas is diminished and its extraction is facilitated.

Gas liquor is, in this country, the most common, and at the same time the most economical, source of ammonia, and the system of extraction by forcing air would, of course, be equally applicable to ammoniacal bone liquor, or to any other chemical preparation in which the caustic ammonia is held in solution.

The principles already indicated may, perhaps, be illustrated with advantage by a brief description of a working-plant actually constructed at Deptford for the purpose of extracting ammonia. An excavation has been made, in which is sunk a reservoir for containing the gas liquor, and having the following dimensions:—namely, 35 feet long, 7 feet wide, and 6 feet deep. The bottom is formed of 1 foot of concrete, two courses of bricks, and of two courses of red flat tiles; the sides are of 14-inch brick-work, two courses with tiles in conjunction with concrete.

The wrought-iron still is set in brick-work, so that flame may play more than half round its external surface. It is 30 feet long by 6 feet in diameter. About 4000 gallons of gas liquor are pumped into it from the reservoir for the purpose of being operated upon.

Heat is applied by means of a fire underneath, but a coil of hot air or steam pipes placed in the interior of the still or boiler would be equally efficacious. Two cast-iron 3-inch air-pipes, which are attached to the ammonia generator, extend along its whole length, and are situated one on either side, and nearly at the bottom. They are perforated with holes increasing in size as they extend from the inlet. Into these pipes, and from them into the gas liquor, is driven atmospheric air by means of a pair of cast-iron force-pumps. These are 20 inches in diameter, 1 foot 8 inches stroke, with rods and slings, wrought-iron connecting rod and crank, and a cast-iron beam 6 feet long. On the entry of the streams of air they are caught and agitated by the twelve iron fans of a stirrer, making about 80 revolutions per minute.

The air, together with the lime and the various constituents of the gas liquor (viz., water, ammonia, carbonic dioxide, sulphuretted hydrogen, sulpho-cyanides, &c.) are thus brought continuously into intimate contact. The air loaded with the volatile alkali which has become eliminated from the solution passes upwards into the steam chest and through a branch pipe into the purifier or washer. This is a small wooden vessel of the capacity of 350 gallons, containing lime and being about one-third full of water. It has a tight head and a stout perforated elm false bottom, the holes being concentric and increasing in number and dimension as they radiate from the inlet, which is brought below the false bottom.

This purifying vessel is furnished with a small agitator having two blades, one revolving above and the other below the false bottom. There are two trial or test taps at appropriate heights, to test for gas or for water, and there is also a pipe sealed at one end, rather less than half way from the bottom, for the purpose of leading away any excess of liquid that may accumulate owing to the condensation of aqueous vapour which may pass over with the volatile alkali. There is a long straight tube or safety pipe from the washer, and the bent pipe from the ammonia generator is also provided with a safety valve and a vacuum valve. In the washer the ammonia is deprived of any remaining hydrosulphuric acid or other impurity that may have escaped being fixed in the generator. About half a bushel of finely sifted slaked chalk lime is found to be a suitable charge for the washer, and when this becomes saturated or impure, it is renewed by means of a pipe and tap placed at the bottom of the vessel. The washer being a close vessel soon becomes full of air and gas, which are forced by the pressure through a pipe opening into the top and leading to a coil or worm placed in a cold water cistern, and terminating in a deep close vessel about one-third full of pure cold water, which has been condensed from the waste steam from the engine. A portion of the ammonia becomes absorbed by the water, but the residue, together with all the air, after bubbling up through the liquid, is conducted by a bent pipe to nearly the bottom of a second similar receiver, and thence in the same way to a third, but which is opened at the top.

The air, having fulfilled its function, is now permitted to escape into the atmosphere, the whole of the ammonia having, however, been arrested.

This last receiver, instead of water contains a strong solution of chloride of iron, which being denser and posses-ing a higher specific gravity than water, offers a greater pressure and resistance to the passage of the gas. The iron salt is, of course, decomposed, with formation of muriate of ammonia in solution, with deposition of a green mud containing sesquioxide of iron, which, after having been calcined, is found to constitute an excellent pigment for rough iron or wood-work.

After the whole of the ammonia has been extracted from the gas liquor, the contents of the still are run off into a draining pit, from which the clear solution finds its way into the sewers, and the solid inodorous lime compounds may be carted away.

This draining pit is constructed of 1½ inch deal boards together with sand and brick-work. It is 4 feet inches wide, 5 feet 4 inches deep, and 10 feet long. There are fillets whereon to rest three perforated shelved platforms. The bottom is formed of perforated de with six inches of sand, also with gravel, and ceme There are channels and small drain-pipes leading int large central earthenware pipe, and from thence i the sewer. The sharp sand, &c., under the perfora boards can be removed at will, and be replaced by fr materials whenever required.

Care must be taken that the large pipe from the bo

to the washer be sufficiently high to guard against any back pressure. The vacuum valve opens and admits air when the fire of the still is withdrawn and the steam becomes condensed.

In order to ascertain the exact state of the contents of the boiler at any required height, and to avoid tapping the upper portion of the boiler at too many places, the following simple contrivance is adopted:—There is one tap at the lower end, to which is attached a short pipe inside the still working easily on an elbow. To this pipe is connected a copper wire having its outlet just above the external surface of the boiler, and by which wire the short pipe may have its orifice presented at any required height, at which it is desired to ascertain the state of the contents of the vessel. For instance, supposing the fire to be withdrawn, and the agitators to be quiescent, if the end of the tube were pulled up by the wire and the tap opened, a clear liquid would issue, which could be tested in order to ascertain whether the whole of the ammoniacal gas had been removed. On the other hand, if the short tube were allowed to lie along the bottom of the still, the opened cock would allow the green sulphocalcareous mud to escape. It is stated in Dr. Miller's "Elements of Chemistry" that, at a temperature of 32°, water takes up about 1050 times its volume of ammonia; at 59°, 727 times, and at 78°, 586 times its volume. Water saturated with ammonia at 60° contains more than one-third of its weight of the gas, increasing in bulk from 1·0 to 1·5, and becoming specifically lighter.

Hence the receiver should be not more than one-third or one-half full of water to allow for the increase in bulk caused by the solution of the ammonia.

In July, 1867, valuable papers upon the utilisation of the waste products of the manufacture of coal gas were read before that important body, the British Association of Gas Managers, by two of our first authorities on this subject, Dr. Letheby and W. Esson, Esq. Dr. Letheby declares that it is so manifestly of the greatest importance that the liquor should be sent away to the gas works as strong as possible; it ought, in fact, never to be under 6° Twaddle, or of less than 12 ounces strength, and with proper condensation and judicious washing there should be from 29 to 30 gallons of such liquor produced from every ton of coals. The price in London is 2s. per butt, 8-oz., with an increase of 4d. per oz. on every additional ounce of acid strength. Below 3° of Twaddle or 5 ounces of acid it does not pay for working, whereas at 10° or 11° of Twaddle it is a valuable product. Both Dr. Letheby and Mr. Esson emphatically insist upon the importance of the strength of the ammoniacal liquor. So rapidly does the commercial value augment, in relation to its concentration that, whereas a butt of 108 gallons of gas liquor is worth 4s., the same quantity of caustic ammonia of specific gravity 0·900 is worth from £15 to £20. A lower strength of gas liquor than 6-ounce has not hitherto been thought worth working, but one advantage in Braby's system of extraction and concentration consists in the fact that a high strength is not indispensable. Even 2 ounces would in practice yield a profit.

As an evidence of the importance of an increased supply of ammonia and of its large demand, it may be mentioned that a firm with which the writer is connected recently offered 4s. per butt of 6-ounce liquor, and yet was unable to obtain a supply, showing that the value has doubled in the short space of two years. Mr. Esson describes an economical arrangement for the extraction of ammonia from gas liquor with the assistance of steam, and by an apparatus similar to a Coffey's still, but which is subject to the disadvantage that the noxious gas (sulphuretted hydrogen) is not simultaneously fixed or disposed of, and that at least 15 per cent of ammonia is left in the liquor, which has afterwards to undergo the supplementary process of distillation with lime. The present ordinary method of making liquor ammonia is, as far as I am acquainted, from sulphate of muriate of ammonia, which is itself obtained from gas water. By Braby's process, liquor ammonia may be obtained much more quickly and economically from gas-liquor direct.

There are many gas-works where ammoniacal salts are now manufactured; but it is suggested that, in new works, or at those where the gas-liquor is not at present utilised, it would be preferable, in the event of the adoption of the principle herein advocated, that the ammonia, after concentration, should be sent to the sulphuric or muriatic acid works, rather than that the acids should be sent to the gas-works. In metallurgy, it is found more advantageous to transport the calcined or partly-prepared ores to the coal districts for smelting, rather than to take the fuel to the mines.

Barges fitted with tanks ordinarily employed in the conveyance of gas-liquor contain from 3000 to 8000 gallons. A land journey of 12 miles with two horses for a load of 500 gallons in a tank-van now costs £1. By rail, the cost of freight is 1d. per ton per mile.

The advantages of the above-described system may be summed up as effecting a considerable economy in labour, time, and occupation of plant, together with the facility of extracting the whole of the ammonia from the gas-liquor in a pure condition. A manufactory previously consuming 10,000 gallons of gas liquor per week, may now utilise 24,000 gallons, and at about half the expense of fuel of that formerly incurred.

The great interest of this subject in a chemical point of view, its high importance to the metallurgist and manufacturer, and the increasing value of ammonia to the farmer (with whom it is almost another name for fertility and abundance), must constitute my apology for having engaged so much valuable time in its consideration.

NOTE ON THE EARLIER HISTORY OF THE SCIENCE OF HEAT.

BY GEORGE FARRER RODWELL, F.C.S.

As a supplement to the lectures on "Heat" which have recently appeared in this journal, it will not, I think, be out of place to give a short account of some of the principal facts connected with the earlier history of the science of Heat. In doing this it will be impossible to preserve any great continuity, my object being rather to indicate some of the old scientific treatises in which experiments are detailed, and to supply the student with a means of reference which the foregoing lectures of necessity could not afford. The memoirs and the works of recent writers on Heat are so well known and so much at the command of all who desire to pursue the study, that it will be sufficient to mention the names only of Cazin, Clausius, Despretz, Franz, Guthrie, Helmholtz, Herschell, Hirn, Joule, Knoblauch, Kopp, Magnus, Mayer, Melloni, Pouillet, Regnault, Balfour Stewart, Tait, Thomson, Tyndall, and Wiedemann.

It is difficult to say when the science of Heat, properly so-called, first arose. It is certainly a younger science than Statics, Dynamics, Hydrostatics, Hydro-

dynamics, Pneumatics, Optics, Static Electricity, and Magnetism. I question whether Acoustics can be added to this list, although it has ever had the stimulating effect of the art of music, which, in its turn, had the stimulating effect of Church Ceremonial, and attained some perfection in the 16th century, and much perfection in the 18th. M. Libri very truly says, "Les recherches des Pythagoriciens sur les vibrations des corps sont les plus anciennes expériences de physique qui soient parvenues jusqu'à nous,"* but we must bear in mind that the results of these experiments were applied to music as an art, rather than to sound as a science. Omitting, then, the question of the precedence of Acoustics, we yet perceive that Heat is among the younger of the sciences. This arises from the fact that, until late in the last century, heat was regarded as a chemical agent, and became merged more or less into chemistry proper. Separate treatises on Heat were unknown, but every chemical work devoted some chapters to the acts and operations of fire, "Car en effet," as Lemery remarks, "c'est par le moyen du feu qu'on vient à bout de presque toutes les opérations chimiques." Hence arose such expressions as "Chymick heat," "ye hete of ye chimists fornace," &c., to designate intense degrees of heat. Then, again, the theory of Phlogiston is essentially a heat theory in one sense, but it has ever been regarded as a chemical theory, because the action of heat is so closely associated with the majority of chemical operations that the scientific cared not to step aside to examine the nature of heat itself, preferring to leave the examination of the cause to study that of the ultimate effect. Boerhaave in his admirable *Elementa Chemiæ*, the most extensive chemical work which had up to that time (1732) appeared, devotes a good deal of space to the "instruments" of chemistry, "beginning," as he remarks, "with fire, by reason that no chemical operation ever was, or can be hereafter performed, to which fire does not contribute." (It may be remarked here that *fire* and *heat* were often used as almost synonymous terms by old writers; thus Boerhaave says "Fire expands even the hardest bodies.") I imagine that Francis Bacon's little treatise, *De Formâ Calidi*, was the first attempt to raise Heat into a separate science. It was an utter failure, yet the attempt is to be applauded, for it was the lack of observation and the paucity and obscurity of the knowledge possessed at that time by the world at large in regard to heat, that of necessity resulted in the failure. What are we to say to such an assertion as the following? "Omnino calor cælestium augetur tribus modis; videlicet ex perpendiculo, ex propinquitate sive perigæo, et ex conjunctione sive consortio stellarum." S. Gravesande in his excellent *Physices Elementa Mathematica*—one of the best illustrated works on Physics which has ever appeared, and which may even now be consulted with advantage,—gives 45 pages ("Editio tertia, duplo auctior," 1742) to heat, and 234 to light. He commences the "Liber de igne" with the very pertinent remark, in his blunt rugged Latinity, "Pauca de igne norunt philosophi; multa ipsos latent," adding very sensibly (and it is to be wished that his example were more often followed) "Hypotheses non fingam; generaliora, quæ experimentis deduci posse mihi videntur, eo quo potero meliore ordine, dicam."

The production of fire by the refraction and reflection of the rays of the sun was well known to the ancients. The sacred fire of Vesta was re-kindled by the rays of the sun reflected from a metallic mirror, and, according to Pliny, the mirror was sometimes replaced by a glass globe filled with water. Aristophanes clearly alludes to the use of glass lenses as burning glasses in the Νεφελαι.

Lactantius, in his curious treatise, *De ira Dei*, mentions that a glass globe filled with water and placed in the rays of the sun, will kindle fire even in the coldest weather.* Baptista Porta in his ever new, ever interesting treatise, *Magiæ Naturalis*—which links the magic of Art of Eastern civilisation with the magic of Nature of Western civilisation, Chaldæan mysticism and Theurgy with the Realism of the Renaissance,—Baptista Porta mentions the fact that heat, sound, and cold may be reflected by mirrors in the same manner that light is reflected. As a delicate instrument of observation in the case of the reflected cold, Porta placed his eye in the focus of the mirror, as, some two and a half centuries later, Dr. Tyndall placed his eye in a focus of dark heat rays in order to see whether any light accompanied the heat rays. Porta's account is interesting; it occurs in the seventeenth book, and is entitled "Calorem, frigus, et vocem speculo concavo reflectere." "Si quis candela in loco," he continues, "ubi spectabilis res locari debet apposuerit, accedet candela per aerem usque ad oculos, et illos calore et lumine offendet, hoc autem mirabilius erit, ut calor, ita frigus reflectitur, si eo loco nix objiciatur, si oculum tetigerit, quia sensibilis etiam frigus percipiet." Somewhat later Hamerus Poppius calcined antimony "per radios solares" with the use of a lens, in order to determine whence came the gain of weight. Bonaventure Cavalieri, the discoverer of infinitesimals, writing in 1632, states that he was able to inflame dry substances by reflecting the heat emitted by a charcoal fire by means of a spherical speculum; by using a parabolic reflector he produced the same effect at a distance of 5 feet, a small fire of wood being the source of heat. He recommends a hyperbolic reflector, and asserts that the impressions of heat, cold, sound, and scent move in straight lines.† Athanasius Kircher has also treated of reflection in his *Ars Magna Lucis et Umbræ*.

The term "radiant heat" was introduced by Scheele in his treatise entitled *Luft und Feuer*. Pictet in his celebrated *Essais Physiques sur le Feu* (1790) demonstrated the enormous velocity of propagation of radiant heat; he also treats of absorption and reflection of heat, and of latent and specific heat. Prevost made known his "Theory of Exchanges" in 1791 through the medium of the *Journal de Physique*.

Black discovered "latent heat" about the year 1760; his pupil Irvine introduced the term "capacity for heat," while Gadolin replaced it in 1784 by the term "specific heat." In connection with the determination of the specific heats of various substances, the following names are most prominent:—Wilke, Lavoisier, Laplace, Kirwan, Dalton, Dulong, Petit, De la Rive, Regnault, Favre, Silbermann, Bérard, De la Prevostaye, and Desains.

* "Histoire des Sciences Mathématiques en Italie." 1838.

* Lactantius was born about A.D. 250; he died in 326. His works were amongst the first printed in Italy; the first edition issued from the press of the monastery of Subiaco as early as the year 1465, while a second issue appeared in Rome in 1468, in both cases it will be remembered before a single book had been printed in this Island. The passage alluded to above is taken from the tenth chapter, entitled "De mundi ortu, et rerum naturæ, et Dei providentia," and is as follows—"Omitto silicem, ac ferrum. Orbem vitreum plenum aquæ si tenueris in sole, de lumine, quod ab aqua refulget, ignis accenditur etiam in durissimo frigore."

† Cavalieri was born in Milan in 1598; he died in 1647. The above is extracted from a work entitled "Lo specchio Ustorio: ouero trattato delle settioni Coniche et alcuni loro mirabili effetti intorno al lume, caldo, freddo, suono, et moto ancora." Bologna, 1632.

As regards the air thermometer I am inclined to think that Galileo invented it about the year 1597; some attribute it to Sanctorio of Padua, others to Cornelius Drebbel of Alcmaer, while others, again, maintain that it was discovered by each of these men independently of each other. Some of the members of the Accademia de Cimento first constructed a fluid thermometer in 1655 or 1656. Edmund Halley introduced mercury in the place of alcohol. Otto von Guericke was the first to take the freezing of water as the lowest limit of the scale, while Renaldini, in 1694, proposed the boiling and the freezing points of water as the opposite limits of the thermometric scale. A kind of rude differential air thermometer is mentioned by Sturmius in his *Collegium Experimentale sive Curiosum* (1676). Sir John Leslie described the differential air thermometer which bears his name, in 1804, in his "Experimental Enquiry into the Nature and Propagation of Heat."

Leslie's principal work is his "Essay on Heat," in which he described the radiative and absorptive power of various substances, and determined the laws which regulate the radiation of heat. He maintained, however, that air is as essential to radiation as it is to convection.

The subject of the conduction of heat was discussed at some length by Lambert in his "Pyrometrie" published in 1779, but the earlier mathematical treatment of the subject is due to Fourier, and is detailed in a paper entitled "Théorie Analytique de la Chaleur," communicated to the Académie des Sciences in 1807. His definition of conductivity is extemely lucid, and he has treated of the cooling of an uniformly heated sphere with great ingenuity and elaboration. Poisson and Carnot have also applied the higher mathematics to the elucidation of various questions connected with the science of heat, and in our day Helmholtz, Clausius, and Thomson.

Mariotte and Hooke observed that glass cuts off many of the rays of radiant heat. M. De la Roche discovered in 1812 that radiant heat which has passed through glass has lost the rays which glass most readily intercepts, and that, as the temperature of the radiating source rises, so does the readiness of the radiant heat to pass through glass increase. Nobili and Melloni worked together on the subject of radiant heat. The former invented the thermopile, while the latter made the important discovery that rock-salt is very transparent to all kinds of heat, and that, by using lenses and prisms of rock-salt, dark heat rays may be refracted exactly in the same manner that light is refracted by glass. These results were published in the celebrated treatise entitled "La Thermochrose, ou la Coloration Calorifique," and were at first received with some credulity by the Parisian *savans*.

The most notable experiments in connection with the polarisation of heat were made by Bérard in 1812 (*Mémoires d'Arceuil*, vol. 3), and later by Forbes.

The Abbé Rochon endeavoured to determine the comparative heating effects of the various coloured rays of the spectrum as early as the year 1776; he employed a flint-glass prism and an air thermometer, and reckoned the heating power of the red rays to be about eight times greater than that of the violet. In 1798 Leslie (?), by using a differential air thermometer, found the calorific energies of blue, green, yellow, and red to be as 1 : 4 : 9 : and 16. In 1800, Sir William Herschell employed a small mercurial thermometer for the same purpose, and arrived at the conclusion that the hottest part of the spectrum is beyond the red rays. A detailed account of recent research on this subject (especially of the "long spectrum of the electric light") will be found in Tyndall's work "On Heat treated as a Mode of Motion."

The history of heat theories has not been alluded to above because the history of the kinetic theory was discussed at some length in the first of the foregoing lectures,* and I have elsewhere† treated of one of the phases of the material theory. Bergman's *De Materia Caloris* may also be consulted by those who are interested in this part of the subject. Of recent works on Heat I would specially mention Clausius "On the Mechanical Theory of Heat;" the treatise of Tait "On Thermodynamics;" the *Théorie De la Chaleur* of M. Desains, and the *Thermodynamique*, of M. Bertin.‡

It is hoped that the above facts—desultory though they be—may be of interest to those who desire to follow the literature of the science of Heat in greater detail than is possible in lectures, which are rather for purposes of demonstration than for the discussion of facts connected with the history of a science.

THE LATE DR. THOMAS GRAHAM, MASTER OF THE MINT.§

ON Thursday, September 23rd, the remains of this distinguished man, attended by a number of his sorrowing relatives and personal friends (among the former of whom were his sister, her husband, and family), were conveyed to their last resting place in the High Church Burying Ground, Glasgow.

But few persons were privileged to any intimate acquaintance with Dr. Graham. He was never strong enough physically to allow him to mix much with society; he was always, or with rare exception, strong enough to toil in the field of science. Even scientific men, owing to his retiring habits, have not seen so fully the bearing of his labours, as they have seen of that of others in kindred pursuits, which will have much less influence. The reason of this will be at once apparent when we consider that he never pursued a merely popular or fashionable subject of investigation, and that he never sought a fashionable assembly in which to disclose the results of his labours, nor did he ever leave his own field of inquiry, although all the highways around him were bustling and busy, and if any person occasionally ventured near him it was only to find that there was nothing to be seen till he pointed something out. We do not pretend to be able to see and appreciate the entire significance of his scientific life—it would for this require much more study than we have given to it—and it will probably require many years for scientific men to develop the ideas originated by him. We can only endeavour to picture to ourselves the scene as he found it, and again as he left it touched by his master hand. Picturing in this connection is scarcely the right word — slight sketching is a phrase too strong for all that we can here attempt.

The general mind of the time has not yet arrived at a right apprehension of chemistry proper. The pre-

* CHEMICAL NEWS, vol. XX., p. 13. (*Am. Repr., Sept.*, 1869, *p.* 129).

† "On the Theory of Phlogiston," *Philosophical Magazine* for January, 1868.

‡ The last two treatises are published in the *Recueil de Rapports sur l'état des Lettres et les Progrès de Sciences en France*, a series of which it would be difficult to speak too highly.

§ Communicated.

vailing notions on the subject, even among well-educated persons, relate to the chemistry of a bygone time, and belong rather to the end of the last century than to the science of the present day. In that earlier time, the elements or simple bodies had been increased in number, and it was that there existed numerous bodies hitherto unsuspected. England had proved the existence of many of these elements, France had arranged them, adding more, and giving a theory of their action, and making a preliminary science from the materials thus created. Lavoisier saw first the qualities of combinations made by metals and other solid bodies with gases, and gave us a definite and clear nomenclature for the science. Wenzel and Richter tried long to make it clear that the constituents of substances must be proportionate and definite, but it did not appear possible to perceive by what innate process these proportions could be produced, and the whole question seemed to involve an impenetrable natural mystery. Dalton, in the simplicity of his mind, looked on matter as composed of exceedingly small bodies, probably round in form, like those conjectured by his great predecessors, from Leucippus to Newton, and thought that if we have one substance represented by black marbles, and another substance by white marbles, neither of which could be broken or divided, we cannot help forming definite compounds in chemically uniting them. That great idea of Dalton has been at the root of all advance in the science, and if any analysis is in contradiction to it, we at once deem it incorrect. When Dalton was publishing his opinions Graham was born, and it seems that from very early manhood it had been his desire to know more of the movements of these atoms. In a paper by him as early as 1829, he showed that diffusion of gases takes place among ultimate particles or atoms, and not between sensible masses. This, then, was a new step. Dalton had shown why they combined in different proportions, Graham showed that there was another property, a distinct movement—a vitality, so to speak, among the atoms. If, as Graham found, gases diffused through porous substances, such as he operated with, they were not driven forward mechanically, so that the mixture should pass like water, but the diffusion volumes are inversely as the square root of the densities of the gases employed in the experiment. If the gases were pressed out or expelled from the containing membrane, no air would return to supply their place; but it was found there was always an interchange of gases—for example, when hydrogen (contained in a tubular glass vessel having its open ends closed with stucco plugs), spontaneously passed through the stucco, air passed in with a velocity denoted by 1277; if carbonic acid were used it passed out whilst air passed in with a velocity of 623 only. Chlorine being used, the air passed in with a velocity equal to 302. From these results Graham was led to believe in Dalton's idea that gases were as *vacua* to each other—an imperfect explanation of the phenomena—although it was empirically correct. In 1831 he said—"The law at which we have arrived, which is merely a description of the appearances, and involves, I believe, nothing hypothetical, is certainly not in accordance with the corpuscular philosophy of the day, and is altogether so extraordinary that I may be excused for not speculating further upon its cause till its various bearings and collateral subjects be fully investigated." Graham leant, however, to the belief that the cause was the existence of an attraction of the particles of one gas for the particles of another, an attraction existing on the surface of the gaseous molecules. This idea led him to study the diffusion of liquids. In this inquiry he came to the conclusion that "diffusion" is a property of a fundamental character upon which the properties depend, such as the volatility of substances. Liquid diffusion thus supplies the densities of a new kind of molecules. "The fact that the relations in diffusion of different substances refer to equal weights of these substances and not to their atomic weight or equivalents is one which reaches to the very basis of modern chemistry. In liquid diffusion we deal no longer with chemical equivalents or the Daltonian atoms, but with masses even more simply related to each other in weight than the former. Holding still by the chemical atoms we may suppose that they can group together in such numbers as to form new and large molecules of equal weight, or of weights which have a simple relation to each other. It is this new class of molecules which appeared to play a part in solubility and liquid diffusion, and not the atoms of chemical combinations." The vast importance of this conclusion, resting upon experimental evidence, every chemist will at once understand.

It will thus be seen that, after a struggle of twenty years, Graham was able to speak of chemical movements not essentially connected with the atomic theory of Dalton. Still, it must be remembered, that these are movements, not combinations. They had, however, an important bearing on decompositions produced by liquid diffusion.

It was in examining this question that he observed the low diffusive power of albumen compared to common salt, for example, and conceived a mode of proximate analysis for mixed animal fluids. Strange to say, he found this diffusive power of liquids was closely allied to volatility. This is due to a cause about the last that even cultivated people generally would have imagined. Diffusion, as practised, was simply the passage through a thin membrane of gelatinous matter, or, as we may say, of parchment-paper as the material used. By observing this he was able to divide bodies in solution into two classes, severally called by him "Colloids" and "Crystalloids." If a liquid containing examples of these two bodies were placed in a vessel, one side of which is of parchment-paper, whilst on the other or outside of it there was water, it was found that the crystalloid substance passed through the paper into the water, whilst the colloid substance remained. In his earlier papers on the diffusion of gases, he had shown that it was only in the hypothesis of self-motion that we could account for the motion of the air within the smaller vessels of the lungs, as they could not be inflated or filled by the action of the chest and diaphragm, which removed only about 20 cubic inches of air at a time, while there were 300 cubic inches of air to be filled and emptied. In this paper on diffusion, the passages of saline fluids through membranes are explained: and the separation of bodies in solution is also shown by a similar self-acting process. We cannot follow him further into his ideas respecting colloid substances, which, he says, possess *energia*. He regards these latter as being matter in a dynamical state, whilst crystalloids are matter in a statical or rest condition. Ever, we should observe, does Graham look at the ultimate properties of bodies; he keeps the atom in view, or, at least, the fundamental matter, and always finding some new property regarding it, freed from the thousand years of exhausted

speculation, but illuminated by experiment and answers obtained by such acute cross-questioning of Nature as no one before him, in that department, at least, ever equalled. We may say, further, without fear of contradiction, no one has succeeded, by such original paths, in obtaining an entrance into the domain of Nature. In speaking of diffusion through membranes, he makes it quite clear that the latter does not act as a filter. The substance is mechanically impenetrable: molecules pass through it, not masses. These molecules are moved by the power of diffusion. It was when examining the action of a septum of caoutchouc separating gases that his attention seems to have been called to the surprising passage of gases through the homogeneous substance of a plate of fused platinum, or of iron at a red heat, as discovered by MM. St. Clare Deville and Troost. He enquired if this had any relation to liquefaction, and concluded that such a term could only be applied in a vague way to bodies so elastic and volatile at an elevated temperature as the gases are, and hydrogen in particular. Still, since dissolving and liquefying must be allowed, with such a fact before us as silver retaining twenty volumes of oxygen at a red heat, Graham also believed that the absorption of gases by a liquid (such as carbonic acid by water) is not a purely physical effect. It appears to involve some relation in composition. In the composition of the bodies, he adds—"May a similar analogy be looked for of hydrogen to liquid on colloid bodies of the metallic class?" It was in following up this idea that he came to the conclusion that hydrogen might pass into metals, and form with them an alloy. This alloy he succeeded in making, and a medal of palladium and hydrogenium was struck in his honour. The hydrogen in this condition and connection was called hydrogenium, in order that the name might have a termination like the names of the metals which it resembled. The palladium contains nine hundred volumes of a substance so light as hydrogen, and so many thousand times lighter than itself. This brilliant discovery had other results. Iron was found to absorb gases when cooling; and it was, therefore, possible to know in what gas iron did cool by finding the gas shut up or included in it. The technical value of this may still be very great; but Graham cared little for such results. He sought cosmic truth; and he had a wonderful proof of his own correctness by the examination of cosmic phenomena. He found that the gas which was shut up in iron made by man was carbonic oxide, but the iron from space, or meteoric iron, contained hydrogen. This gas he took for us out of the meteoric iron, and burnt it. It was hydrogen. Strange that at that time a small star had increased in brilliancy, and become a large one. The spectroscopist found, by the evidence of the spectrum lines, that hydrogen was burning. Graham's quiet and, to all appearance, uninteresting, unimportant, and even dull, experiments, that nobody cared to share with him, had at last resulted in two of the most brilliant facts, which even cultivated minds must long wonder at and admire. Reference to one of his latest speculations must finish our present notice of this distinguished man. That gases have initial movements as one of their original properties, and that the speed of these movements severally may be their main distinction. This would take them out of the region of chemistry proper, and bring them into physics; but physics and chemistry are, after all, fundamentally one. A new field is unfolded to us; new work must be done, and new workers are required. Who among us will give up all the ordinary gratifications and amusements of life to work in this field like Graham? Who among his fellow chemists will do work worthy of being placed beside his? We may freely say that such another will not soon arise, and, if our country produces such a man in a century, she does her duty well, even if the rest are only of average powers.

We cannot go into the detail of the labours of Graham. We have left out his enquiries into the action of water, basic and constitutional, in chemical compounds; his able papers on the arseniates and phosphates; and we have said nothing of osmotic force by name; neither have we done justice to his enquiries on effusion and transpiration; but we have hastily, after his funeral, tried to remember the main points of a great scientific life, and we trust they will be more closely studied than heretofore by all scientific men. We are almost ashamed to allow such a meagre account to stand as representative of the labours of such a man; but it is only for a little, as a longer and more detailed life must soon be written by men who will give much time, care, and competent thought to every portion of the publication. We need scarcely speak of Graham in private. Such enquiries will always have one result in showing that he was pure-minded, just, generous, and kind-hearted to the uttermost. Humble he was, quiet, and as simple-minded to the last as if he were always the same hoping, trusting youth that he seemed to be when he first began to lecture in the Andersonian Institution thirty-nine years ago. By his death, Scotland has lost, at a somewhat early age, one of her brightest scientific names, and Great Britain and the world one of the greatest chemists of the present or of any period.

A CHEMICAL METHOD OF TREATING THE EXCRETA OF TOWNS.*

BY EDWARD C. C. STANFORD, F.C.S.

THIS paper is intended as a continuation of two former papers read before the Glasgow Philosophical Society, and published together in the CHEMICAL NEWS, under the title of "A Chemist's View of the Sewage Question."

In these papers, I have endeavoured to show that the water-closet system of disposing of human excreta, unless it undergoes some great modification, can never be regarded as the perfect system of the future. I have strongly urged the general adoption of the dry-closet, as avoiding all the great evils which are apparently inseparable from the use of water as a vehicle; and pointed out the use of charcoal, by which its application to towns and cities is simple and easy. Since these papers were published, further experiments have been made, which strongly confirm the opinions already advanced, and form the subject of this paper.

Amongst other objections to the use of water as a carrier, I have specified—

1. The enormous cost of the works required, in proportion to the small amount of noxious material to be removed.

2. The large annual outlay required to keep the closets in order. Experience, in large cities, has shown that, on this account, these closets are quite unsuitable for the dwellings of the poor.

3. The enormous amount of water employed (estimated at 365 times the weight of the excreta), where,

* Read before the British Association, Exeter Meeting, Section B.

as in many towns, there is much difficulty in obtaining it.

4. That it results in a subterranean flood of filthy water, which must flow somewhere; and, wherever it flows, it pollutes the region, thus disseminating and distributing the evil.

5. This material, worth about 30s. per ton, has its value reduced, by dilution, to 1d. per ton, which it is impossible, by any known chemical method, to extract with profit.

6. The large generation of noxious gases in the sewers, which constantly escape into our streets and houses.

In reference to the latter, Dr. Gairdner speaks strongly of almost all sewers, as "diffusing poisons upwards and downwards," and too often "carrying backwards, into the very heart of the dwelling, the reflux gases, the produce of the decomposition of the impurities of a whole neighbourhood."

Dr. Fergus characterises the sewers as "a gigantic laboratory under our dwellings," from which noxious gases escape, by gully holes into our streets and pipes into our houses.

He has furnished me with a number of extracts from eminent medical authorities, which conclusively show the highly dangerous character of the miasma occasioned by the infiltration of sewage water and the evolution of sewer gas.

Of these I shall only make two quotations, which should be sufficient to convince any one of the important bearing of this question on the national health:—

Extract No. I.

Mr. Simms's *Second Report* (1860) *of* Dr. Greenhorn's *Investigations in Several Towns in England.*

Pages 59 and 60.—"*Diarrhœal diseases* are increasing in this country; they vary in different districts, from 4 to 663 per 100,000 persons. If the diarrhœal death-rate of England generally were only ten times the minimum diarrhœal death-rate, there would be an annual saving in England of nearly 20,000 lives."

"In the districts which suffer the high diarrhœal death-rates, the population either breathes or drinks a large amount of putrefying animal refuse."

Page 61.—"If the diarrhœal death-rate of England is reduced to that which prevails among the healthier parts of the population, typhoid fever (now, probably, the cause of at least 15,000 annual deaths) will be reduced in more than equal measure; and in proportion as infantile diarrhœa is reduced, the convulsive disorders and respiratory inflammations of infancy (which now cause fully 60,000 annual deaths) will also show a large, if not equal, reduction of death-rate."

Page 64.—"The excess of mortality has, in all cases, been coincident with one or other of two local circumstances—(*a*). *The tainting of the atmosphere with the products of organic decomposition, especially of human excrement;* or (*b*), *the habitual drinking of impure water.*"

Extract No. II.

From Mr. Simon's *Ninth Report to the Privy Council.*

Pages 32, 33, and 34.—"*Cholera* derives all its epidemic destructiveness from filth, and especially from excremental uncleanliness."

"It cannot be too distinctly understood that the person who contracts cholera in this country is, *ipso facto*, demonstrated with almost absolute certainty to have been exposed to excremental pollution; that what gave him cholera was, mediately or immediately, cholera contagion discharged from another's bowels; that, in short, this diffusion of cholera among us depends entirely on the numberless filthy facilities which are let exist, and especially in our larger towns, for the fouling of earth, and air, and water, and thus, secondarily, for the infection of man with whatever contagion may be contained in the miscellaneous outflowings of the population. Excrement sodden earth, excrement reeking air, excrement tainted water; these are, for us, the causes of cholera. Cholera ravaging here at long intervals is not Nature's only retribution for our neglect in such matters as are in question. *Typhoid fever and much endemic diarrhœa are, as I have often reported, incessant witnesses to the same deleterious influence. Typhoid fever, which annually kills some* 15,000 *to* 20,000 *of our population; and diarrhœa, which kills many thousands besides.*"

Dr. Fergus has drawn attention to a remarkable but very common and fruitful cause of the escape of sewer gas into houses. He frequently noticed, when attending patients suffering from gastric fever, a peculiarly sickly and offensive odour, and in all cases traced it to the leaden syphons and soil-pipes of the water-closet. On examination, these were generally found to be perforated with holes, sometimes of considerable size, through which the sewer gases freely escaped into the house. The evil exists to an extent which will scarcely be credited by those who have not specially investigated the subject. A long length of soil-pipe will often be found bulged outwards in little swellings, each of which, sooner or later, open, and present apertures for the escape of sewer gas. If the pipe be laid, as it often is, under a bed-room floor, this may go on for years, until at last the pipe is taken up in a perfect honeycomb of deterioration; and we may pretty safely predict the sanitary condition of that bed-room and of its occupants. I have been informed by plumbers that it occurs most quickly where chloride of lime has been used; but the necessity for the use of this shows that the evil had existed before its application. The pipe becomes covered in the interior with a whitish-brown powder of which four specimens were examined; the composition is shown below:—

	I.	II.	III.	IV.
Carbonate of lead.....	2·70	86·00	91·00	92·90
Carbonate of lime....	80·63	2·50	2·10	2·90
Water.....	0·45	1·20	1·00	0·50
Lead insoluble as oxide	—	3·50	1·50	1·45
Silica.....	1·35	2·80	1·00	1·60
Organic matter.....	14·87	4·00	3·40	0·65
	100·00	100·00	100·00	100·00

The lead put down as insoluble is combined, apparently, with a kind of fatty acid, represented as organic matter. In No. 1, chloride of lime has evidently been recently used. The pipes are all taken from different closets, and arranged in an increasing order of deterioration. The action is probably caused by the carbonic acid, aided by the other gases of decomposition, and the fatty matter of the excreta producing carbonate of lead under somewhat similar conditions to those which obtain in its manufacture on the large scale; the carbonate of lime being derived from the solid excreta. This view requires confirmation; but one fact is obvious (and it is sufficient to show that the water-closet has been introduced before we have studied its effects)—that leaden pipes so much con-

demned for carriage of water for drinking purposes are even more unsuitable for house drainage; and the reason given explains, to a certain extent, what is generally admitted—that the common earthenware syphon forms the cleanest water-closet.

None of the disadvantages enumerated attend the use of the dry-closet; still less can any of these gigantic malaria evils result from its general adoption. It meets every sanitary requirement, which, after all, is the main consideration. Moreover, its machinery is simple and inexpensive. It effects at once a great saving of water; and it enables us to secure the whole of the value of the excreta. I have pointed out the only objections which can be urged against its application in large cities to be, when dry earth is used; the large amount required (three and a half times the weight of the excreta), the difficulty of obtaining such a supply, and the large cartage necessary: three and a half times the weight to be removed into the city, and four and a half times the weight to be carried out.

Now, by using charcoal, these objections are entirely removed; for it only requires one-fourth the quantity as compared to earth, and, by re-burning the charcoal, the supply is provided from the excreta itself; and the cartage is reduced to the weight of the material carried into the city, and twice its weight carried out. The quantity per diem for a population of 500,000 is calculated at 385 tons in, and 770 tons out; a quantity about the same in Glasgow as the city ashes.

Moreover, charcoal has other advantages over earth. It is a powerful deodoriser, and its employment guarantees a perfect immunity from odour quite unattainable by any water-closet; and it blackens and conceals the excreta so perfectly that no one seeing the product from the closets for the first time would have the least notion from its appearance what it was. As, also, the dust would always be sifted out for sale as manure, the charcoal used in the closets would always be of proper size, and no dust could be projected in the working of the closet. Such a closet could be kept in every bedroom without the possibility of becoming a nuisance, if only attended to; but, in houses constructed for the purposes, the closets on the several floors would be over one another, and the product from each fall through a 12-inch pipe to a small cesspit below the house, and this need only be emptied once a year. The small size of this pit may be imagined when it is mentioned that 1 cwt. of charcoal per month will be sufficient for each closet if used by six persons daily, and one cart load per annum will empty the pit.

Use of Charcoal in Latrines.—I have shown, in a former paper, how the use of seaweed charcoal in latrines effects its composition, by converting the carbonate of lime it contains into phosphate. The results published were from experiments with ten, twenty, fifty, and one hundred times its weight of urine evaporated down. I found that, though in all cases there appeared to be no appreciable loss of ammonia in drying, when the last product was re-burned alone, only half the nitrogen came over as ammonia, though the whole was obtained by soda lime. As, however, I propose for latrines the charcoal should be used ten times before re-burning, I have undertaken a complete series of experiments, the results of which are given in Tables A, B, and C, showing the composition of the chars after each re-burning, up to ten re-burnings and one hundred uses. The results are as regular as can be expected from the variable composition of the substance operated on. It will be seen that the residual chars rise, after five or six re-burnings, to about 25 per cent phosphate of lime, while the carbonate is reduced to 2 per cent. After having attained this composition at which it becomes regular, it would be advisable to add a certain proportion of fresh seaweed char, to prevent the phosphoric acid remaining soluble, of which a trace now appears, and to secure a regular supply of a good sugar refiners' charcoal, which would add a considerable value to it. In any case, the phosphate of lime thus gradually deposited is quite equal to a soluble phosphate for agriculture on account of its finely divided condition. The average yield of ammonia by simple re-burning is about equal to the calculated amount, and shows clearly that neither in the drying nor in the distillation has any been lost. The total yield is 316 per cent on the char, or 31·6 per cent for each re-burning. The total increase of char is 183 per cent, or 18·3 per cent for each re-burning.

The density of the char has increased 131 per cent in the ten re-burnings, the increase being merely in the first five re-burnings. The ammonia only was estimated in the destructive distillation. The increments of potash and phosphoric acid are pretty regular, that of sulphuric acid remarkably irregular. The commercial result of this process for latrines would be as follows:—Supposing the char sold as a manure after ten uses, 1 ton would produce, allowing 15 per cent for moisture, 30 cwts. of manure, containing nitrogen equal to 20 per cent sulphate ammonia, 7 per cent phosphate lime, and 5 per cent sulphate potash, and worth at least £5 per ton, or equal £7 10s., whilst it would have cost £2 for the char, 30s. for cartage, reckoned at 10 tons carted in and 20 tons carted out at 1s. per ton, or a profit of 80s. on each ton of char used. If, again, the char be used fifty times, and re-burned five times, its cost will be increased by cartage to £9 10s., and, by five re-burnings at 3s. 6d., to £10 7s. 6d., and in quantity, allowing 11 per cent for moisture, to 2 tons, the cost being thus £5 3s. 9d. per ton, and its value, containing 12 per cent phosphate lime, reckoned as insoluble, and 15 per cent sulphate of potash, is £5 per ton, in addition to which nearly 30 cwts. of sulphate of ammonia are yielded in the five re-burnings, worth, at 16s. per cwt., the sum of £24, less the cost of acid. If, however, the char be as good a sugar refiner as I suppose, its value will be much above that stated. In this case, however, the char would have to be washed, and the amount would be less by the amount of soluble matter it contains from which the potash could be separated. It would be easy, of course, to increase the soluble phosphate for some crops by the addition of mineral phosphate rendered soluble.

Use of Charcoal in Closets.—The experiments, the results of which are given in Tables D and E, were made with one of Smith's self-acting dry-closets, used by several lads.

No. 1 was distilled wet, Nos. 2 and 3 dry. After this, the charges were dried, and returned to the closet, and used again before being re-burnt. Nos. 8, 9, and 10 are complete analyses; and what is deficient in the others is calculated from these. A portion of the ammonia comes over combined with acetic acid, which is separately shown, and also the acetic acid as acetate of lime. The average results per deposit and per cent of wet and dry excreta are also shown. The composition of several of the resulting chars, and the increase per cent of the several ingredients, are shown in Table E. After No. 3, the compositions are pretty similar; and this may be taken, therefore, to be the char from ex-

creta. The char commenced with was only 3 lbs., or 48 ozs., to which 18 ozs. were afterwards added, the total amount employed being 66 ozs. At the end of the experiment, it amounted to 123 ozs., 57 ozs. being derived from the excreta; and yet this small original stock served 181 uses of the closet and absorbed 808 ozs. of wet excreta, having been dried and re used seventeen times, and re-burnt ten times. It increased about 66 per cent in density, then remaining constant, but was in every respect better adapted for the closet, and improved by the treatment, the charge being still under 8 ozs. at the end of the experiment. The distillation yielded over 38 ozs. of sulphate of ammonia, or nearly 7 per cent of the wet excreta. I propose that the mixture should be dried and re-used five times before being re-burnt: this has not been done in these experiments, as I was impatient for results. Where this is done, a considerable quantity of gas is given off in the distillation, and, from the large amount of fatty matter, it possesses considerable illuminating power. This fatty matter is characteristic of excreta, and is shown in the large quantity of tar yielded in the distillation—over 9 per cent; wood only yielding 10 per cent, and coal 12 per cent. The yield of ammonia equals 31 per cent of sulphate, showing this to be a most prolific source. It is remarkable that the re-burning shows the products of distillation of vegetable matter—acetic acid, for instance, combined with those

TABLE A.

RESIDUAL CHARS.—COMPOSITION PER CENT.

	Ordinary Char.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Water	10·00	—	—	—	—	—	—	—	—	—	—
Soluble Salts	0·60	9·00	17·60	27·00	36·20	41·80	49·20	51·20	54·80	56·80	59·20
Insoluble	89·40	91·00	82·40	73·00	63·80	58·20	50·80	48·80	45·20	43·20	40·80
Soluble.											
Chlorine =	—	4·87	8·56	13·32	16·80	19·32	23·31	26·46	28·56	29·40	31·08
Chloride of sodium	—	8·11	14·26	22 17	28·00	32·20	38·83	44·00	47·60	49·00	51·80
Sulphuric acid	0·30	0·51	1·02	1·37	3·50	3·70	4·11	2·00	2·05	2·22	0·68
Phosphoric acid	—	—	—	—	—	—	—	—	trace	trace	trace
Potash	0·30	2·30	4·20	4·60	7·69	8·07	10·76	10·96	11·15	11·73	12·40
Insoluble.											
Carbon	54·40	40·00	40·60	35·80	32·20	33·20	26·20	26·00	23·40	23·40	23·40
Silica	9·10	12·40	12·40	11·20	8·80	6·20	6·20	5·60	5·20	4·40	3·20
Phosphate of lime	4·80	6·60	8·40	10·20	11·60	12·00	12·20	11·60	11·40	10·40	10·50
Carbonate of lime	17·40	24·20	15·60	11·60	7·40	3·60	2·80	1·20	0 40	0·40	0·90
Carbonate of magnesia	3·10	5·80	4·40	3·00	3·00	3·00	2·40	2·00	1·60	1·40	1·10
Specific gravity (relative)	1000	1254	1636	1659	1744	1822	1915	1995	2274	2294	2313

WASHED CHARS—DRY.

	Ordinary Char.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Carbon	61·12	44·94	49·87	49·71	51·11	57·24	52·40	55·31	54·41	58 59	59·24
Phosphate of lime	5·39	7·41	10·31	14·16	18·41	20·68	24·50	24·68	26·51	26·00	26·58
Carbonate of lime	19·55	27·19	19·16	16·11	11·74	6·20	5·60	2·54	0·93	1·00	2·28
Carbonate of magnesia	3·48	6·51	5·40	4·02	4·76	5 17	4·80	4·25	3 71	3·50	2·88

TABLE B.

TOTAL INCREASE PER CENT ON ORIGINAL CHAR USED.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Dry solid matter	33·25	79·55	126·45	166·45	217·65	249·65	295·65	347·69	391·50	455·09
Char	6·20	23 08	44·71	59 65	80·61	98·48	116·88	136·68	154·24	183·40
Sulphate of ammonia	30·07	69·02	89·70	117·28	147·86	178·30	210·01	246·26	276·91	316·26

RESIDUAL CHARS.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Water	—	—	—	—	—	—	—	—	—	—
Soluble salts	8·14	21·05	38·28	56·96	74·64	96·81	109·99	128·73	143·67	166·93
Insoluble	5·36	12·15	14·28	12·04	15 36	11 18	16·00	17·21	20·33	26·06
Soluble.										
Chlorine =	5·16	10·53	19·18	26 71	34·77	46·15	57·03	67·40	74·58	88·95
Chloride of sodium	8 59	17·53	31·92	40·52	57·96	76·88	95·04	112·33	124·46	146·59
Sulphuric acid	0 24	0·95	1 67	5·26	6·36	7·84	4 02	4·54	5·34	1·62
Phosphoric acid	—	—	—	—	—	—	—	trace	trace	trace
Potash	2·13	4·86	6·32	11·93	14 22	21·01	23·37	26·01	29·49	34·79
Insoluble.										
Carbon	*12·00	*4·47	*2·85	*3·31	5·36	*2·53	1·76	0·82	5·04	11·82
Silica	4 04	6·15	7·02	4·89	2·06	3·17	2·99	3·17	2·07	*0·05
Phosphate of lime	2·19	5·53	9·88	13·64	16·80	19·36	20·25	22·10	21·61	24·92
Carbonate of lime	8·25	1·78	*0·70	*5·64	*10·92	*11·86	*14·81	*16·46	*16·38	*14·86
Carbonate of magnesia	3·04	1·01	1·22	1 67	2·30	1·65	1·22	0 67	0·45	0·01
Specific gravity	25·40	63·60	65·90	74·40	82·20	91·50	99·50	127·40	129·40	131·30

* Decrease.

[English Edition, Vol. XX., No. 517, pages 198, 200.]

TABLE C.

INCREASE PER 1000 PARTS OF URINE.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Average.
Dry solid matter	33·25	39·77	42·15	41·61	43·53	41·60	42·23	43·46	43·51	45·51	41·66
Char	6·20	11·54	14·90	14·91	16·12	16·41	16·69	17·08	17·13	18·34	14·93
Sulphate of ammonia	30·07	34·51	29·90	29·32	29·57	29·71	30·00	30·78	30·73	31·62	30·62

RESIDUAL CHARS.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Average.
Water	—	—	—	—	—	—	—	—	—	—	—
Soluble salts	8·14	10·52	12·76	14·24	14·93	16·13	15·71	16·09	15·96	16·69	14·12
Insoluble	5·36	6·07	4·76	3·01	3·07	1·86	2·28	2·15	2·26	2·60	3·34
Solub'e.											
Chlorine =	5·16	5·26	6·37	6·68	6·95	7·69	8·14	8·42	8·28	8·89	7·18
Chloride of sodium	8·59	8·76	10·64	10·13	11·59	12·81	13·58	14·04	13·83	14·66	11·86
Sulphuric acid	0·24	0·47	0·55	1·31	1·27	1·30	0·56	0·56	0·59	0·16	0·70
Phosphoric acid	—	—	—	—	—	—	—	trace	trace	trace	—
Potash	2·13	2·43	2·10	2·98	2·84	3·50	3·34	3·25	3·27	3·48	2·93
Insoluble.											
Carbon	*12·00	*2·23	*0·71	*0·83	1·07	*0·42	0·25	0·10	0·56	1·18	*1·30
Silica	4·04	3·07	2·34	1·22	0·41	0·53	0·42	0·39	0·23	—	1·40
Phosphate of lime	2·19	2·76	3·27	3·41	3·36	3·22	2·89	2·76	2·40	2·49	2·87
Carbonate of lime	8·25	0·89	*0·23	*1·41	*2·18	*1·98	*2·11	*2·06	*1·82	*1·48	*0·41
Carbonate of magnesia	3·04	0·50	0·40	0·42	0·46	0·27	0·17	0·08	0·05	—	0·59
Specific gravity	25·40	31·80	21·96	18·60	16·44	15·25	14·21	15·92	14·37	13·13	18·71

* Decrease.

TABLE D.

RESULTS OF TREATING CLOSET EXCRETA.

No. of Expt.	No. of Deposits.	Weight, Wet.	Weight, Dry.	Char Used.	Char Produced.	Char, Increase.	Liquid Distilled.	Tar.	Acetate of Lime.	Free Ammonia as Sulphate.	Combined Ammonia as Sulphate.	Total Ammonia as Sulphate.	
		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Grs.	Grs.	Grs.	Grs.	
1.	7	Estimated weight, 490 ozs.	Estimated weight, 110 ozs.	48·00	48·00	—	65·50	Estimated weight, 10 ozs.	Estimated weight, 1977 grs.	1229·00	Estimated weight, 1712 grs.	11310	Partial Analyses.
2.	6			48·00	48·00	—	21·50			643·00			
3.	5			44·00	48·00	4·00	20·50			613·00			
	18												
4.	19			76·00	81·50	5·50	37·50			1310·00			
	37												
5.	24			80·50	93·00	12·50	38·50			1721·00			
	61												
6.	24			93·00	104·00	11·00	34·50			1852·00			
	85												
7.	24			98·00	107·50	9·50	39·50			2230·00			
	109												
8.	24	113·00	36·00	104·50	111·50	7·00	53·50	2·50	479·60	1756·00	268·00	2024·000	Complete Analyses.
	133												
9.	24	93·00	18·00	105·50	108·50	3·00	34·50	2·50	503·60	1502·00	343·00	1845·000	
	157												
10.	24	112·00	18·00	98·00	102·50	4·50	33·50	1·50	300·80	1278·00	215·00	1493·000	
Total	181	808·00	182·00	795·50	852·50	57·00	379·00	16·50	Ozs. 7·46	Ozs. 32·32	Ozs. 5·81	Ozs. 38.130	
								Grs.	Grs.	Grs.	Grs.	Grs.	
Average per deposit		4·46	1·00	4·39	4·71	0·32	2·09	39·76	18·01	78·08	14·02	92·100	
Per cent, wet		100·00	22·44	98·43	105·62	7·19	46·86	2·04	0·92	6·24	0·71	6 950	
Per cent, dry		—	100·00	439·00	471·00	32·00	209·00	9·10	4·12	27·84	3·19	31·030	

Char dried and used seventeen times; re-burnt ten times. The distillations also produced about 1 oz. of light hydrocarbon.

[English Edition, Vol. XX., No. 517, page 199.]

TABLE E.

ANALYSES OF CHARS FROM CLOSET.

	Ordinary Char.	Composition. 1.	2.	3.	4.	5.	6.	Increase, per cent. 1.	2.	3.	4.	5.	6.
No. of Deposits		37	85	109	133	157	181	37	85	109	133	157	181
No. in Table D		4.	6.	7.	8.	9.	10.	4.	6.	7.	8.	9.	10.
Water	10·00	1·20	1·20	2·00	1·80	—	—	—	—	—	—	—	—
Soluble	0·60	4·70	9·20	8·30	10·10	9·20	9·60	4·10	8·60	7·70	9·50	8·60	9·00
Insoluble	89·40	94·10	89·60	89·70	88·10	90·80	90·40	4·70	0·20	0·30	*1·30	1·40	1·00
Soluble.													
Chlorine =	—	2·16	3·45	3·69	4·16	4·50	4·75	2·16	3·45	3·69	4·16	4·50	4·75
Chlorine of sodium	—	3·60	5·75	6·15	6·93	7·50	7·91	3·60	5·75	6·15	6·93	7·50	7·91
Sulphuric acid	0·30	0·85	1·00	trace	1·02	0·68	1·40	0·55	0·70	—	0·72	0·38	1·10
Phosphoric acid	—	trace	trace	trace	trace	trace	trace	trace	trace	trace	trace	trace	trace
Potash	0·30	0·30	4·10	3·46	3·46	4·61	5·57	—	3·80	3·16	3·16	4·31	5·27
Insoluble.													
Carbon	54·40	41·80	42·20	44·80	41·50	44·00	43·40	*12·60	*12·20	*9·60	*12·90	*10·40	*11·00
Silica	9·10	15·20	12·40	12·50	12·80	12·00	11·80	6·10	3·30	3·40	3·70	2·90	2·70
Phosphate of lime	4·80	13·50	15·60	20·00	21·06	21·20	21·40	8·70	10·80	15·20	16·26	16·40	16·60
Carbonate of lime	17·40	20·40	12·40	8·60	7·00	11·60	11·20	3·00	*5·00	*8·80	*10·40	*5·80	*5·40
Carbonate of magnesia	3·10	3·50	5·60	1·20	2·10	2·00	2·00	0·40	2·50	*1·90	*1·00	*1·10	*1·10
Specific gravity (relative)	1000	1319	1638	1720	1769	1700	1667	31·90	63·80	72·00	76·90	70·00	66·70

WASHED CHARS.

	Ordinary Char.	Composition. 1.	2.	3.	4.	5.	6.	Increase, per cent. 1.	2.	3.	4.	5.	6.
No. of Deposits		37	85	109	133	157	181	37	85	109	133	157	181
No. in Table D		4.	6.	7.	8.	9.	10.	4.	6.	7.	8.	9.	10.
Carbon	54·40	44·46	47·98	51·43	49·13	49·43	48·22	*9·94	*6·42	*2·97	*5·27	*4·97	*6·13
Phosphate of lime	4·80	14·37	17·41	22·96	24·93	23·34	23·77	9·57	12·61	18·16	20·13	18·54	18·97
Carbonate of lime	17·40	21·70	13·83	9·87	8·28	12·77	12·44	4·30	*3·57	*7·53	*9·12	*4·63	*4·96
Carbonate of magnesia	3·10	3·30	6·25	1·37	2·48	2·09	2·22	0·20	3·15	*1·73	*0·62	*1·01	*0·88

* Decrease.

from animal matter, as ammonia, for example, arising from the mixed nature of the human food. These experiments were conducted on excreta from poorly-fed lads; amongst good livers, the nitrogen, phosphates, and fatty matter would probably be much increased. These tables represent, therefore, the minimum yield. Taking these data, 1 ton of char which had been used five times would yield, allowing 15 per cent moisture, 48 cwts. of manure, containing nitrogen equal to 18 per cent sulphate of ammonia, 15 per cent phosphate of lime (reckoned as soluble), and 7½ per cent sulphate of potash, and worth £7 per ton. Its cost for char, £2, and for cartage, 5 tons in and 10 tons out, equal 15 tons at 1s., equal 15s. If advisable to hasten its sale by drying, it would cost 10s. more, the total cost being £3 5s., or about 28s. per ton. If re-burnt and returned to the closet, the re-burning would cost 3s. 6d. per ton, or 8s. 6d., and yield over 8 cwts. sulphate of ammonia at 16s., equal £6 8s. less cost of acid, and, allowing 10 per cent for moisture, 33 cwts. of char, partly to return to the closet and partly for sale as manure, and worth about £5 per ton. I think these data are sufficient to show that this process presents the means of recovering the total value of the excreta. In addition, there are other unexpected sources of further profit; for 100 tons of dry, solid excreta yield 9 tons of tar and 4 tons of acetate of lime, besides a considerable quantity of richly-illuminating gas.

I have brought this subject before the Section in the full belief that it must some day become a chemical question; and I maintain that engineers have shown their incompetence to deal with it alone. Water-closet excreta is now admitted to be the worst poison to put into our rivers; and why should such volumes of water be thus employed for such pollution? If this large amount of water be unnecessary, if, moreover, it be grossly wasteful and fearfully prejudicial to health, it becomes our duty to discuss any other method by which chemistry may be made available to secure that which has hitherto been lost. I repeat here my conviction expressed in a former paper—that "Every system of sewage, to be permanent, must give back to the soil that which in our food we have taken from it; and the mere ridding ourselves of a valuable fertiliser simply on account of difficulty in dealing with it is unworthy the enlightened spirit of our age." At the same time, I admit that considerations of health must always precede those of wealth in this respect, and no system need be spoken of against which there is a whisper of suspicion on this point.

Nothing can be said against the dry-closet in this respect. It has already become a recognised institution. It presents the best means at present known of confining a nuisance within its proper limits, instead of distributing it amongst our neighbours, and therefore merits our patient consideration.

There can be no doubt that, for country houses, the earth-closet is free from objection; but there is also no doubt that, with earth, it could not be applied to large towns; but, with the modification proposed, its use will be profitable in direct proportion to the size of the town. By its use we are enabled to store the manure for the farmer, and dispose of it when he wants it, and not whenever we want to get rid of it, which materially affects the market price.

While, therefore, there can be no doubt of the healthfulness of this process, I believe enough has been proved in this paper to show that the gradual introduction of char-closets will become national stepping-stones to health and wealth.

THE

CHEMISTRY OF THE BLAST FURNACE,

ACCORDING TO

MR. I. L. BELL'S EXPERIMENTS.*

BY CHARLES SCHINZ.

Mr. I. Lowthian Bell has lately read before the Chemical Society a paper on "The Chemistry of the Blast Furnace," this paper which is published in the Journal of the Society for June last, containing an account of a series of experiments which he has made on the process of the reduction of the iron ores in the blast furnace, and by means of which he intends to prove that this reduction takes place at a temperature much lower than that previously found by Scheerer, Ebelmen, and Tunner.

Mr. Bell comments at first upon the irregularity with which the layers in the blast furnace come down, and judges from that, that the volume of the blast furnace cannot be divided precisely into "zones." It should be stated, with regard to this, that it is absolutely wrong to charge a furnace with pieces varying much in size, this variation, of course, producing an unequal reduction and an irregular descent of the layers. But if this mistake is often made in England, it does not follow that the temperature in the blast furnace, with careful charging, should not decrease in an uniform and constant manner, so that it may really be divided into zones, limited by fixed temperatures: a difference of temperature is not even a necessary consequence of charging the furnace with pieces of unequal sizes, as the hot gases give up the heat with equal rapidity to large and small pieces, because this transfer depends simply upon the heat-conducting power of the materials. If, however, the free space between the pieces of the charge is not the same on both sides, the gases will rise much quicker on one side than on the other.

Of course small pieces of ore are more quickly and more completely reduced than larger ones, but large pieces, as well as small pieces, will be acted upon according to the existing temperature by the rising carbonic oxide; while, if they descend to such a depth of the furnace that the slag begins to run, the reduction ceases entirely, and afterwards it can only be accomplished, at a still higher temperature, out of the slag which contains oxide of iron by means of solid carbon. But that cannot influence the action of a zone of reduction, for the reduction by means of solid carbon is a different action, including other phenomena, and has to be examined separately.

If now the experimenters above named fixed the limits of their zones at very different heights of the shaft of the furnace, they have either erroneously taken the depth of the furnace as the extreme limit, whilst the volume of the zones ought to have been decided, or but very uncertain means of determining the temperature must have been at their command.

Mr. Bell has, on the other hand, put the ores to be reduced for a greater or less time into the iron pipes by which the gases are led from the furnace, and, moreover, into the pipes of furnaces of different size which, of course, give off gases of different temperatures; and, as he has thus found that a reduction takes place even at the melting point of bismuth (257° C.), he argues consequently that all that has been formerly stated about the temperature necessary for the reduction must be wrong. If Mr. Bell has really measured his temperature in a correct manner, of course then he is entitled to this conclusion; but it is a question whether Mr. Bell's measurement of the temperature does not depend upon a delusion. All compact metals possess a much greater heat-conducting power than the ores. If we put upon the bottom of a gas-pipe pieces of ores and a piece of metal, the latter will not melt, for the atmospheric air cools the tube from below, and deprives the piece of metal which is in contact with the tube of the heat necessary for the melting, whilst the pieces of ores, with less conducting power, are exposed to a perceptible higher temperature.

If we suppose that the temperature of the pieces of ore was the same as that of the piece of metal which served for ascertaining the temperature, the conclusion at which Mr. Bell arrived is still only delusively correct, for the conditions of the chosen method of operating are different to those existing in the blast furnace. The quantity of gas passing through in proportion to the mass of ores is much larger in the pipe leading off the gas than in the shaft of the furnace itself. My own experiments (see *Documente Betreffende den Hokofen*) have proved that the reduction is as much accelerated by the proportionate quantity of gas as by the amount of carbonic oxide which these gases contain, and that the intensity of the reduction, therefore, depends together upon temperature, quantity, and abundance of CO, and that no comparable results can be obtained without taking into consideration, and without determining, all these three factors. The influence of the composition of the gases upon the process of reduction has been presumed by Mr. Bell, and he has, therefore, made special experiments with gases of the furnaces at Wrbna and at Clarence.

These gases have, according to Mr. Bell, the composition:—

13 CO + H, 16 CO_2, 71 N (Wrbna), and
32 CO + H, 6 CO_2, 62 N (Clarence).

But such a composition of blast furnace gases is almost impossible, for these gases must contain, if no direct reduction by means of solid carbon takes place, for 100 equivalent of nitrogen, 26·6 equivalent of vapourised carbon, and 26·6 equivalent of oxygen, plus the oxygen added by the reduction of the ores.

Now, the gases of the Wrbna furnace contain:—

13 CO and 16 CO_2
6·5 " 16 = 22·50 O
for 100 N = 31·69 O;

the surplus of oxygen from the ores would thus be only—

31·69 − 26·51 = 5·18;

well, but whence came the 16 CO_2?

Besides 13 CO and 16 CO_2 contain
6·5 " 8 vols. = 14·5 C.,

which gives 20·42 carbon instead of 26·51 for 100 N.

The result of Tunner's analysis is, therefore, decidedly wrong.

The composition given for the gases of the Clarence furnace, namely:—

32 CO, 6 CO_2, 62 N,

is just as false.

These gases contain 22 volumes of O for 62 N, and this for 100 N = 35·48 O; next, also, they have 19 carbon for 62 N, or for 100 N there would be 30·64 carbon. The surplus of O thus equals 8·88 per cent, and of C = 4·04 per cent.

* *Engineering*, October 22, 1869.

[English Edition, Vol. XX., No. 518, page 205.]

The gases of Clarence Iron Works should have, according to Mr. Bell's own calculation, the composition—

Cold Blast.

Weight of carbon	32·79 = volume		30·48
" " oxygen	50·22	"	35·11
" " nitrogen	142·60	"	113·48

per 100 N = 26·86 C. / 30·94 O.

Hot Blast.

Weight of carbon	23·34=volume		21·76
" " oxygen	35·82	"	25·04
" " nitrogen	92·73	"	60·74

per 100 N=35·82 C. / 41·22 O.

The surplus of oxygen would be, in the first case, 4·43 per cent, and in the latter case 14·71 per cent; the surplus of carbon in the first case, 9·31 per cent, and in the latter case, 0·35 per cent. But that does not correspond with the analysis which gives surplus of O =8·88, and surplus of C=4·04.

I only mention this examination of the analyses in order to show how easily such analyses are used for final conclusions, without proving whether they are really correct.

The incorrectness of these analyses had no influence upon the application which Mr. Bell has made of them. He intended to show with the first composition of gases that reduction still takes place even with a small proportion of CO, and that has really been the case; but not the least thing is proved by that, for oxide of iron when brought into contact at a sufficient temperature with gases which contain only a trace of CO, will change that CO into CO_2, if not as easily, at least as completely, as oxide of copper, which is used for ascertaining by means of combustion the quantity of CO contained in gases.

Mr. Bell next discusses the question, how the saving of fuel by means of a hot blast is to be explained. We have here especially to mention that with a cold blast an increase of the fuel will always produce a product richer in carbon and graphite, whilst an increase of the temperature by means of a hot blast will never secure the same success. This fact alone should have opened long ago the eyes of mining engineers as to the real cause of the effect of the hot blast; for if a hot blast effects a saving of fuel in the furnace, the disposable amount of carbonic oxide will be naturally much decreased, and the reduction as well as the carbonisation of the product, by that agent, will be prejudiced. But as all, or almost all, iron is gained from the ores by applying a hot blast, the reduction which cannot any longer be produced in a complete manner by carbonic oxide, must necessarily be effected by means of solid carbon. This is the solution of the problem relating to the wonderful effect of the hot blast.

The diagrams (deduced from Ebelmen) which Mr. Bell gives, and which show that with a cold blast CO appears only 5 feet about the tuyeres, whilst with a hot blast this height is increased to 9½ feet, lead to a very erroneous conception of the case. Although these results of Ebelmen were both obtained at Clerval, the construction of the furnaces differed very much from each other. The furnace of 1839 with hot blast had only a capacity of 11·27 cubic metres, whilst the capacity of the furnace of 1841 with cold blast was 23·98 cubic metres, and the total heights of these furnaces were only 8·67 and 10 metres.

Calculating now the volumes of the separate parts of the furnace, we find that in the one furnace, as well as in the other, with hot blast as well as with cold blast, carbonic oxide alone exists after the blast has passed through a fifth of the total capacity of the furnace.

113 kilos. of coals, requiring 3880 kilos. of air for their transformation into CO, are consumed per hour if a hot blast is applied. If these 3880 kilos. are heated to 182° C., $3880 \times 0{\cdot}24 \times 182 = 169478$ units of heat are introduced into the furnace, the heat representing $\frac{169478}{2400} =$ 70·6 kilos. of coals.

The heat in the furnace corresponds thus with a quantity of coals equal to 113+70·6=183·6 kilos. If a cold blast is used, 153·5 kilos. of coals are hourly consumed. The quantity of heat in the furnace with a hot blast is thus greater by an amount equal to 183·6—153·5=30·1 kilos. of coals. Whereas the hot blast produces per hour only 85 kilos. of pig-iron, and the cold blast only 119 kilos.

The consumption of fuel in the furnace is thus per 1 kilo. of the product:—

$$\text{For a hot blast} = \frac{11}{85} = 1{\cdot}33.$$

$$\text{For a cold blast} = \frac{153{\cdot}5}{119} = 1{\cdot}29.$$

The latter system is, therefore, the most advantageous one, and the favourable effect of the hot blast disappears in the present case altogether. But the only reason for that is, that the capacity of the furnace with a cold blast is more than twice as great, as this increase of the capacity has the same effect as the hot blast.

Mr. Bell tries to prove the same thing in a different manner, but he makes from the beginning a mistake by supposing that equal quantities of heat must give the same results; his experiments are, therefore, in this respect without any value. It can also not be admitted that increase of the height of the furnace effects, under any circumstances, the same saving in the consumption of fuel as the hot blast. An increase of the height of the furnace, without altering the other dimensions proportionately, demands also a greater pressure of the blast, which can only be produced by an increase of power; but this increase of power requires for its generation also an increase in the consumption of fuel. Mr. Bell ought to have said that an increase in the *capacity* (instead of an increase in the height of the furnace) effects a saving.

But, also, an increased capacity of the furnace produces only then a saving of fuel equivalent to the hot blast, as at Clerval, if the hourly consumption of coal in the larger furnace is not greater than in the smaller furnace, as it was the case at Clerval, where the proportion of the consumption was $\frac{113}{153{\cdot}5}$ and that of the capacity $\frac{11{\cdot}27}{28{\cdot}96}$. Only in that case the capacity of the zone of reduction is increased in proportion to the ores passing through, and that is what has to be attempted in order to produce a cheap and, at the same time, good pig-iron.

ON THE SYNTHESIS OF GLUCOSIDES.

BY M. P. SCHÜTZENBERGER.

ETHERS composed of sugar, and considered as polyatomic alcohols, are generally designated under the name of glucosides and saccharides. The synthesis of glucosides has only been effected at present with sundry organic monobasic acids (butyric, acetic, stearic, benzoic), by two methods.

[English Edition, Vol. XX., No. 518, pages 205, 206.]

1st. By the direct union of two compounds (sugar and hydrated acid), subjected to a prolonged contact and to a temperature of between 100° and 120° (Berthelot).

2nd. By the action of acetic anhydride upon sugar (Schützenberger). This latter method is less general than the former, but has the advantage of producing an entire transformation in a very short space of time.

My object has been to utilise the easy production of acetic derivatives from sugar, to prepare by double decomposition glucosides which are more complex, and whose composition more nearly approaches that of natural products, such as salicine, amygdaline, quercetine, rhamnine, &c. Here are the results of my researches.

1. Upon heating with benzine a mixture of soda-saligenine, $C_{14}H_{13}NaO_3$, and triacetic glucose at the boiling point of benzol, the following are formed:—Monacetic salicetine $C_{14}H_{11}(C_2H_3O)O_2$, glucate of sodium or an analogous salt, acetate of sodium, and a small quantity of a substance soluble in water, alcohol, benzol, precipitable by acetate of lead, and capable of being split up sharply into salicetine and glucose by boiling with dilute sulphuric acid. If triacetic glucose be replaced by diacetic glucose or diacetic saccharose, reactions of the same kind will be obtained. Under these conditions acetic sugar and soda-saligenine exchange their acetyle and their sodium, a small portion of the bodies present reacts in another way, producing acetate of sodium and a glucoside containing the elements of saligenine.

2. Better results are obtained by heating, in the presence of water, a mixture of acetic glucose and the plumbic compound of saligenine. The quantity of saligenic glucose thus formed is then much greater. I do not insist upon the centesimal composition of this product, as I have been unable to crystallize it, and do not know if it be a definite and unique compound.

3. An aqueous solution of acetic saccharose was heated with the plumbic compound of rhamnetine. The latter is perfectly insoluble in water, and yields on separation, rhamnegine, the colouring matter of buckthorn berries, acetate of lead, and a glucoside colouring matter soluble in water and alcohol, staining tissues yellow mordanted with alumina.

This glucoside colouring matter is precipitated by the acetate of lead which forms simultaneously; it is obtained in a state of purity by decomposing with sulphuretted hydrogen the yellow deposit remaining after the experiment. The soluble yellow pigment separates, upon boiling with diluted mineral acids, into glucose and insoluble rhamnetine.

4. Acetic sugars, amygdaline, salicine, acetic tannin, when heated with an aqueous solution of benzoate of soda, yield acetate of soda, and corresponding benzoic derivatives, of which more will be said at a future time.

The facts here stated prove that the method of double decomposition applied to acetic derivatives of sugar, has succeeded partially, and might, perhaps, serve for the synthesis of complex glucosides.—*Comptes Rendus.*

REPORTS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 5, 1869.

E. W. BINNEY, F.R.S., F.G.S., *Vice-President, in the Chair.*

"*On Nontronite*," by T. E. THORPE, Ph.D., communicated by Professor H. E. Roscoe, F.R.S., &c.

There exists some doubt among mineralogists as to whether nontronite is to be regarded as a distinct mineral species. Owing to the difficulty of obtaining it in a fit state for investigation, the few analyses hitherto published by Berthier, Dufrénoy, Jacquelin, and others, have taught us but little concerning its real nature. The following analysis, made on a comparatively pure specimen, may throw additional light on the constitution of this compound. The sample analysed was discovered, unclassified, in the Mineralogical Cabinet at Heidelberg, and was stated by Professor Blum, who was disposed to regard it as pinguite, to have been found in the neighbourhood of Heppenheim, in the Bergstrasse.

1·4155 grms. of the substance was heated with fuming hydrochloric acid until the mineral appeared to be completely decomposed. The solution was evaporated to complete dryness, and the separation of the silica effected in the usual manner.

Silica obtained, 0·5680 grms.

The weighed silica was then dissolved in caustic potash, and proved to be entirely free from sand or quartz.

To the filtrate from the silica were added a few drops of nitric acid, the solution boiled, and the iron precipitated by ammonia.

Ferric oxide, 0·5757 grm.

The weighed precipitate was next dissolved in strong hydrochloric acid, water added, and the solution filtered from a minute quantity of silica which had escaped separation by the previous evaporation.

Silica (not completely separated), 0·0030 grm.

Caustic soda was then added in slight excess to the filtrate, and the ferric oxide again precipitated, washed, ignited, and weighed. The re-precipitated ferric oxide weighed 0·5740 grm. Hence the substance was free from any appreciable quantity of alumina.

To the ammoniacal filtrate a few drops of ammonium oxalate were added, and the precipitate ignited, and determined as caustic lime.

Lime, 0·0380 grm.

On adding sodium phosphate to the filtrate, a mere trace of magnesia, appearing only after the lapse of some hours, was found.

The remaining constituent (namely, water) was determined by igniting the mineral in a stream of dry carbonic acid, carefully freed from air, until the loss of weight appeared constant.

1·1205 grms. substance lost 0·2311 grm. water.

Calculated from the foregoing analysis, the composition of the mineral is as follows:—

Lime	2·68
Magnesia	traces
Ferric oxide	36·44
Silica	40·30
Water	20·98
	100·40

On subtracting the lime, which evidently may be regarded as an unessential constituent, the percentage composition agrees very well with that required by the formula Fe_2O_3, $3SiO_2+5H_2O$.

	Found.	Calculated.
Ferric oxide	37·24	37·20
Silica	41·29	41·86
Water	21·47	20·94
	100·00	100·00

Nontronite is evidently a product of the decomposition by weathering of some siliceous mineral rich in iron. It possesses a light green colour, which, on the expulsion of water, changes to a dark chestnut-brown. It is perfectly opaque, and shows no evidence of crystallisation. Its fracture is uneven, and the lustre of its streak resinous. It is

unctuous to the touch, and yields easily to the nail, and is somewhat harder than talc.

The following analysis by Biewend, made upon a specimen found at Andreasberg, agrees remarkably well with the foregoing determinations:—

Ferric oxide	37·30
Silica	41·10
Water	21·56
	99·96

Dr. Schunck, F.R.S., called attention to a paper by Vogelsang and Geissler, on the nature of the liquids enclosed in certain minerals, such as rock crystal, topaz, and quartz, which appeared in the number of *Poggendorff's Annalen* for last May. The authors find that these liquids (supposed by some observers to be hydrocarbons) always consist of liquid carbonic acid, mixed, in some cases, with a little water. The experiments by which they were led to this conclusion are fully described in the paper.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of every chemical paper in the world, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers on a level with the latest advances of science.*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

The Saline Deposits of Turkestan.—M. Palm.—The author says that he was sent on a long journey through a very little frequented portion of the Asiatic part of the Russian empire, and that, during that time, he studied especially those saline deposits which are not chiefly composed of common salt, known by the German name of *salz-steppen*. The first deposit alluded to in this paper is met with near Fort Perowski, and consists of alternate layers of a saline mass and fine white sand, impregnated with a salt soluble in water. As instances of the composition of this salt, we quote the following analysis from this paper:—Percentical composition—NaO, 42·4; SO_3, 54·8; water, 2·0; sand, 1·0. Sulphate of soda, 47·215; common salt, 2·719: water, 48·50; sand, 1·566; formula—

$$NaO, +SO_3Saq. + 1\text{-}14th\ eq.NaCl.$$

Sulphate of soda, 57·26; common salt, 10·18; water, 35·56; formula—

$$10(NaO,SO_3) + 2(NaCl) + 9HO.$$

The author describes very minutely these deposits, and a number of others, stating that several millions of tons of sulphate of soda are deposited in this far away region, inhabited only by a few Nomadic tribes, and by Cossacks, who do duty along the great roads as a military police.

Very Black and Very Cheap Ink.—M. R. Voigt.—Take 12 ozs. of extract of logwood, 1½ lbs. of best nutgalls, 1 lb. 6 ozs. of dried sulphate of iron (*sulphas ferri ustum*), 1 lb 1½ ozs. of senegal gum, 1 oz. of commercial sulphate of copper, ½ a drachm of corrosive sublimate, and 45 lbs. of water. The nutgalls, previously ground to a coarse powder, are macerated for four days with 12 lbs. of previously well boiled, and afterwards quite cooled, water, taking care to place the mixture in a cool place. The extract of logwood is also dissolved by itself in 12 lbs. of the same water; the previously dried sulphate of iron is dissolved by itself in 5 lbs. of that water; the sulphate of copper is, also, separately dissolved in ½ a lb. of water. The quantity of corrosive sublimate is, likewise, separately dissolved in 4 lbs. of the said water, while the gum is dissolved in 9 lbs. of that same fluid. Each of these solutions should be filtered, either through a very fine hair sieve, or through linen; and, after that, the solutions should be mixed together in the same order as they are here enumerated. The ink thus obtained should be bottled, and the bottles, after having been well corked, kept in a cool place. 1 lb. of this ink can, according to this author, be had for the low price of 6 kopéiks (about three farthings).

On Mercurialin.—M. Reichardt.—The preparation of this substance from the *Mercurialis annua* is given at length; it is a complicated process, requiring great nicety of manipulation. Mercurialin is an oily fluid, at first colourless, but readily becoming brownish tinged by the action of heat, as well as by simple contact with air; it is an alkaloid, exhibiting a strongly alkaline reaction to test paper. The formula of mercurialin, as deduced from its salts, is C_3H_2N. The author has studied a series of the salts of this substance, most of which salts crystallise, and some are capable of forming well-defined double salts.

Steam-Boiler Incrustations.—M. E. Wiederhold.—The author states that the hardest incrustations of this kind are formed when the quantity of carbonate of lime amounts to from 20 to 25 per cent of the entire mass. He has found by an experience extending over several years, that some kinds of clay, among these, the substance known as *kieselschiefer* (a peculiar fatty clay), when suspended in the water contained in steam-boilers, prevent the particles of carbonate and sulphate of lime dissolved in the water, even if the latter is very hard, to cling together, and become fixed to the sides of the boilers, forming there a hard incrustation. A series of experiments, made on purpose, and continued for a sufficient length of time to yield a reliable result, has fully proved that the addition to the feed-water of the steam-boilers of fatty clays, especially the kind known as fuller's earth, entirely prevents boiler incrustations, even where, of necessity, very hard water has to be used as feed-water. A loose, soft mud is deposited as soon as the motion of the water, due to the boiling, ceases on cooling. This mud readily runs off on opening the sludge-valve of the boiler.

Zeitschrift für Chemie, von Beilstein, No. 14, 1869.

This number contains only two original papers:—

Reduction-Products of Mononitroazoxybenzol.—G. A. Schmidt.—It appears that the author had been engaged with researches on this subject some eight years ago, but had not then gone very deeply into it. Meanwhile it was taken up by various other experimenters, and among them, also, M. Alexejeff, who wrote and published a monograph on the subject in the Russian language. This circumstance induced the author to resume his work; and he proceeds with the reduction of the nitroazoxybenzol as follows:—One part, by weight, of that material is dissolved into ten parts of strong and boiling alcohol. While boiling temperature is kept up, there is gradually added a strong alcoholic solution of sulphide of ammonium, in small quantities of from 2 to 3 c.c. at once, and this is continued until all nitroazoxybenzol is dissolved, and none of it appears to crystallise out on a few drops being taken out of the boiling fluid as a test and cooled down. The formation of analine and β phenyldiamin is in this way entirely prevented. To the liquid, after having been decanted from the precipitated sulphur, a mixture of weak spirit and excess of hydrochloric acid is added, whereby muriate of amidoazobenzol is formed; this is a solid substance, exhibiting crystalline form, and possessed of a violet blue colour and metallic lustre. When to these yet impure crystals is added a little ammonia and weak spirit, there is obtained a golden yellow-colored crystalline mass, insoluble even in boiling water, but readily soluble in alcohol and ether; this pure material fuses at

127°. This muriate, or hydrochlorate, yields, on being treated with excess of ammonia, the amidoazoxybenzol, a solid substance fusing at 130·5°, comprised according to the formula $C_{12}H_8(NH_2)N_2O$, nearly insoluble in cold water, a little soluble at the boiling point of that fluid, and readily soluble in strong alcohol, ether, and benzol.

On Trinitroazoxybenzol.—G. A. Schmidt.—When azoxybenzol is treated with a mixture of nitric and sulphuric acids, a trinitro product is obtained. The author mixed, in a flask, 20 grms. of azoxybenzol with 200 grms. very strong nitric, and 100 grms. of concentrated sulphuric acids. The azoxybenzol dissolves without giving off red vapours (but becoming very hot, the mixture is to be poured into cold water immediately), and yields a bright yellowish crystalline mass, glued together by a resinous product. After having rubbed up with some water, and placed on a filter, washed and dried, the resinous matter is dissolved, and thereby the trinitroazoxybenzol obtained as a crystalline powder, insoluble in water, very difficultly soluble in alcohol and ether, and readily soluble in benzol. It is best purified by re-crystallising it from nitric acid of 1·38 sp. gr. wherein it is readily soluble on being boiled, and crystallises on cooling. It fuses at 152°, solidifies at 140°, and explodes rather sharply when heated more strongly. Formula, $C_{12}H_7N_6O_7$. The resinous matter referred to contains binitroazoxybenzol, or isomeric substances, researches about which still occupy the author.

Comptes Rendus des Séances de l'Académie des Sciences, September 13, 1869.

This number, an unusually small one, contains, among its most remarkable communications, the startling intelligence that the manuscripts and signatures, about which M. Chasles has made so much fuss, are nothing but the work of a clever forger, who, by dint of study and perseverance, has been enabled to carry on a very successful, but, happily, now interrupted, business. M. Dumas read a small portion of a lengthy memoir on the—

Spectrum of the Solar Spots, as observed by the Rev. Father Secchi, S. J.—This paper, and the following, on the—

Constitution of the Luminous Spectra (M. Lecoq de Boisbaudran) are too lengthy, on the one hand, and too concisely written, on the other, to admit of any useful abstraction.

Researches on the Nature of the Products of Fermentation of Glycerine produced by Microzymas.—M. Béchamp.—The author briefly reviews the labours of M. Redtenbacher on this subject, stating that that chemist had transformed glycerine, after addition of beer yeast, into propionic acid. The author of this paper has applied to his researches a mixture consisting of pure glycerine, 250 grms.; chalk, from Sens, full of well and lively-moving microzymas; hashed mutton, quite fresh, and previously washed with cold water, 30 grms.; cold water, 3000 c.c. This mixture has been kept at a temperature of from 35° to 40° for several months. The chief results obtained by the author are, that propionic, butyric, caproic, and valeric acids are formed most abundantly; among the gaseous products, carbonic acid, hydrogen, and nitrogen are found as result of this fermentation.

September 20, 1869.

This number contains the following original papers relating to chemistry or sciences allied thereto:—

Preparation of Nitrogen.—Mr. Calvert.—The author suggests that a mixture of hypochlorite of lime and sulphate of ammonia be made in the following manner:—200 c.c. of an aqueous solution of hypochlorite of lime, containing 5·14 of hypochlorous acid, to which is added, 1·146 of sulphate of ammonia, previously dried at 220°; nitrogen gas is immediately given off, even without the application of heat, but it is better to apply heat very gently. The author observes, further, that all nitrogenised animal matters (such as albumen, fibrin, gelatine, silk, feathers, and skin) yield, when mixed with a solution of hypochlorate of lime, especially when heat is applied, a large quantity of nitrogen and carbonic acid. Ulterior researches on this subject are promised.

Researches on the Microzymas of the Blood and on the Nature of Fibrin.—MM. Béchamp and Ester.—This is, strictly speaking, a physiological paper. It is somewhat curious to learn that the coagulation of blood should be due to the juxtaposition and agglutination of minute globules (not the blood corpuscles) and that these globules should be microzymas, and capable of effecting the saccharification of the starch.

Heat Emitted from the Moon.—M. Marié-Davy.—According to the very accurate researches and experimental observations of this author, the heating power of the rays of the moon is incapable of raising the one-millionth part of a degree the temperature of a very sensitive air-thermometer covered with lampblack. This result disagrees with the results obtained by Lord Rosse, when he made observations on this subject.

New Kind of Gunpowder.—M. Brugère.—The author mixes 54 parts of picrate of ammonia and 46 parts of nitrate of potassa; on burning off, this mixture only leaves carbonate of potassa. The following formula explains the reaction:—

$$C_{12}H_2(NO_4)_3NH_4O_2 + 2(KO,NO_5) = 10CO_2 + 6N + 6H + 2(KO,CO_2).$$

The author states that this powder presents the following advantages over ordinary powder:—It is more homogeneous, and its effects are consequently more regular; it is far less hygroscopic; it is more effective for equal weights; and it leaves far less solid matter on combustion. The residue left after combustion does not affect metals, since it is only carbonate of potassa; this powder hardly emits any smoke at all, and what little is emitted is devoid of smell. The author recommends a mixture of 25 grms. of picrate of ammonia, 67 grms. of nitrate of baryta, and 8 grms. of sulphur, as an excellent substitute for Bengal light, and as suitable for signal and port lights, and use in theatres, since hardly any smoke is emitted and no unpleasant smell given off, while the light is very brilliant, slow burning, and yields a beautiful greenish tinge.

Annalen der Chemie und Pharmacie, July, 1869.

This number contains the following original papers:—

New Mode of the Formation of Nitro-Prussides.—M. Städeler.—The author begins this monograph by a lengthy description of the manner in which he ascertained the composition of the orange-coloured precipitate which ensues when a solution of cyanide of potassium is added to a solution of a proto-salt of iron. The quantitative estimation of the proportions of the proto-salt of iron and of the cyanide of potassium were found to be in relation as 3:4, or 4:5; the formula for the orange-coloured precipitate alluded to is, accordingly, Fe_2Cy_5K. In order to test the accuracy of this formula, the author tried to convert the orange-coloured precipitate into a nitro-prusside, according to this schematic formula—

$$Fe_2Cy_5K + NO.OK = FeO + Fe(NO)Cy_4K_2.$$

The result of experiment confirmed the correctness of the author's opinion; but the reaction was not found to take place so simply, for, instead of the formation of protoxide of iron and nitro-prusside of potassium, there is formed magnetic oxide of iron and the nitro-prusside; the formation of the nitro-prussides without acids is, therefore, the author's discovery. The orange-coloured precipitate above alluded to is converted into nitro-prusside by being treated with nitrite of potassium, best, after that orange-coloured body has become oxidised, by exposure to air. A portion of the paper is devoted to the discussion of the correctness of the for-

mula generally adopted for nitro-prussides, and due to Gerhardt's researches on this subject.

On Anisaldehyde.—Dr. Rossel.—The author first reviews the labours of MM. Cahours, Piria, Cauizzarro, Bertagnini, and others, on this subject. The author states that the anisaldehyde is best prepared by mixing 1 part of essential oil of anise, 2 parts of bichromate of potassa, 3 parts of concentrated sulphuric acid, and 8½ parts of water. When 100 grms. of the essential oil are operated upon, about 50 per cent of aldehyde is obtained. The raw product, after having been purified, exhibits a nearly colourless fluid, of 1·1228 sp. gr. at 18°; it is readily soluble in alcohol and ether, but not so in water; its reaction is neutral, but, since it oxidises very readily to anisic acid, a few drops of the aldehyde, on exposure to air, become solid, and, at the same time, exhibit acid reaction to test-paper. This aldehyde is composed of $C_8H_8O_2$. The author has succeeded in obtaining the several derivatives from this anisaldehyde, among which are anisoine, $C_{16}H_{16}O_4$, a solid substance crystallising in six-sided prisms, hydranisoine, isohydranisoine, desoxyanisoine, and anishumine.

On Diphenyl.—M. Brönner.—While engaged in rectifying a large quantity of benzol, made by the distillation of a mixture of benzoate of lime and slaked lime, there remained in the retort a solid crystalline substance, which was found to be insoluble in water, and readily soluble in ether and in boiling alcohol, from which latter solution it was obtained in a pearly, crystalline mass, fusing at 70·5°, and which, on being submitted to elementary organic analysis, yielded results leading to the formula, $C_{12}H_{10}$—that is to say, the same as the substance M. Fittig obtained by acting with sodium upon monobrombenzol. The reactions of the latter substance, as described by Fittig, and tried by the author of this paper, with the substance obtained by him in the manner above described, agree in all respects; and there is no doubt, therefore, that both materials are identical, and deserve to bear the same name.

Relations existing between Amylen and Oil of Turpentine.—Drs. Bauer and Verson.—The chief leading points of this memoir may be summarised thus:—1st. Two molecules of amylen form one molecule of diamylen—

$$C_5H_{10}+C_5H_{10}=C_{10}H_{20}.$$

2nd. Diamylen and bromine form diamylen-bromide; and this last-named substance forms rutylen, when it is treated with an alcoholic solution of caustic potassa—

$$C_{10}H_{20}Br+2KHO=2KBr+2H_2O+C_{10}H_{18}.$$

3rd. Rutylen forms, with bromine, a bromide of rutylen, and this, on being treated with an alcoholic solution of caustic potassa, yields the new hydrocarbon—

$$C_{10}H_{16}Br+2KHO=2KBr+2H_2O+C_{10}H_{16}.$$

$C_{10}H_{16}$ is evidently related to tereben, which, as observed by M. Berthelot, is the "terme commun et stable auquel tous les carbures, $C_{10}H_{16}$, viennent aboutir."

Products of the Action of Chlorous Acid upon Naphthaline.—M. Hermann.—The products obtained by this reaction are—An acid containing chlorine, phthalic acid, the acid potassa salt of a new sulpho-acid, and bichloride of naphthalin. The author describes these products, and many of their combinations, at great length. The formula of the chlorine containing acid is $C_{16}H_7ClO_5$; this acid readily forms salts, most of which crystallise. The bichloride of naphthaline, $C_{16}H_8Cl_2$, is a solid crystalline substance, fusing at 68°, and soluble in alcohol. The new sulpho-acid above named is *Naphthochinonsulpho acid*, the potassa salt of which contains, in 100 parts:—Carbon, 36·73; hydrogen, 1·22; potassium, 12·00; chlorine, 10·87; sulphur, 9·79; oxygen, 29·39. Formula, $C_{16}H_4KClSO_6$.

Specific Heat of Saturated Vapours.—M. J. A. Groshans.—This paper, a very learned essay on this subject, being entirely based upon higher algebra, is not well suited for abstraction.

Some Derivatives from Creosol.—M. Biechele.—The author first reviews the labours of Hlasiwetz, Hugo Müller, Gorup-Besanez, Sobrero, and others, on this subject; and then he describes a series of his own experiments, treating first on creosol-potassium—

$$C_8H_9KO_2+2H_2O.$$

Creosol, obtained by decomposing the salt just named by means of sulphuric acid. The substance thus obtained is, after purifying, a colourless, oily liquid, highly refractive, boiling between 209° and 220°, becoming a solid mass when treated with ammonia, and reducing salts of silver to the metallic state; formula, $C_8H_{10}O_2$. Creosol-sulpho acid.—The result of the action of sulphuric acid upon rectified creosote is a liquid readily absorbing water from the atmosphere; its formula is $C_8H_9O_2.SO_3H$. This acid forms, with baryta, oxide of lead, and potassa, salts readily soluble in water. When chloride of phosphorus acts upon creosote, the chloride of creosol, C_8H_9OCl, is among the products.

Action of Hypochlorous Acid upon Butylen.—M. Lieben.—By this reaction, butylen-chlorhydrin, chlorinated dibutylen-chloride, are obtained; but the very concise description given by the author, of a long series of rather complicated chemical operations, cannot be readily condensed. The formula of chlorinated dibutylen-chloride is—

$$\left\{\begin{matrix} C_4H_8Cl \\ C_4H_7Cl.Cl \end{matrix}\right.$$

Since the oxidation of an alcohol obtained from butylen-chlorhydrin yields acetic acid, the author states as his opinion, based upon his researches, that the alcohol just alluded to is ethyl-methyl-carbinol.

The two remaining papers in this number are taken, one from the *Proceedings of the Royal Society*, the other from the *Comptes Rendus*, and have both been already abstracted in our pages.

August, 1869.

This number contains the following original papers:—

Amines of Xylyl-Alcohol.—Dr. O. Pieper.—Chlorine gas is first passed into boiling xylol, and the chloride so formed is treated at 116°, in sealed tubes, with a strong solution of ammoniacal gas in alcohol. The contents of the tube, after the reaction was finished, was treated with alcohol; and this fluid, along with excess of ammonia, was removed by distillation. The author thus obtained trixylylamine, $(C_8H_9)3N$, a colourless, viscous, oily fluid, specifically lighter than water, not soluble in that fluid, difficultly soluble in alcohol, but readily soluble in ether. Hydrochlorate of trixylylamine, $(C_8H_9)3N,HCl$, a solid substance, exhibiting perfectly snow-white needle-shaped crystals, not soluble in water and ether, difficultly soluble in cold, but readily in hot alcohol, and fusing at 212°. Bixylylamine, $(C_8H_9)2HN$, a somewhat yellowish coloured oil, exhibiting an alkaline reaction to test-paper, specifically lighter than water, insoluble therein, soluble in alcohol and ether, and decomposed if heated above 210°. Xylylamine, $(C_8H_9)H_2N$, also an oily liquid, boiling at 196°, soluble in alcohol and ether, and insoluble in water; it attracts carbonic acid from the air, and solidifies.

Decomposition of Tri- and Bi-Benzylamine by Heat.—Dr. L. Brunner.—The author divides his essay in two parts, treating in the first on the products of distillation of tri- and bi-benzylamine. Among the fluid products is toluol, boiling at 112°. Among the solid products, dibenzyl, $C_{14}H_{14}$, obtained, after re-crystallisation, in large foliated shiny crystals fusing at 52°; toluylen, $C_{14}H_{12}$, a solid body, fusing at 120°. Among the residues of the distillation, left in the retort, and treated of in the second part of this essay, we notice lophin, $C_{21}H_{16}N_2$, a solid body, crystallising in needle-shaped crystals, fusing between 260° and 270°. When lophin is placed in a current of dry hydrochloric acid gas, and a dry current of carbonic acid gas passed over it, the compound $C_{21}H_{16}N_2.2HCl$ is formed.

Amines of Chlorinated Benzyl-Alcohol.—M. Berlin.—By a complicated process, described at too great length for any useful abstraction, the author has obtained a series of chlorinated compounds, and combinations of these with other substances. We notice among them—Chlorinated tri-benzylamine $(C_7H_6Cl)3N$, a solid substance, soluble in alcohol, and fusing at about 89°. Chlorinated bi-benzylamine $(C_7H_6Cl)_2HN$; the author discovered no less than four varieties of this base, designated, respectively, α, β, γ, and δ, and studied the salts they form. Chlorinated benzylamine, $(C_7H_6Cl)H_2N$, a colourless liquid, readily soluble in alcohol and ether, but not in water; it attracts carbonic acid from the air, and is thereby converted into a solid substance.

Variable Behaviour of Iodine towards Hydrosulphuric Acid under Divers Conditions, and the Causes thereof.—M. A. Naumann.—This essay treats on the part water (and what the author calls thermochemical action) plays in the reactions between iodine and sulphuretted hydrogen gas. Dry sulphuretted hydrogen and iodine, dissolved in anhydrous sulphide of carbon, do not act at all upon each other; neither does sulphuretted hydrogen act upon solid iodine, or vapours thereof if water is excluded. The greater portion of this essay is not well suited for abstraction.

Researches on Phloron and Cresol, and some of their Derivatives.—A. von Rad.—This is a lengthy monograph on the subject named; the mode of treatment and the concise manner in which it is written make it unsuitable for condensation.

Conversion of Urea into Carbaminic Acid.—M. H. Bunte.—About 8 grms. of nitrate of urea were mixed with absolute alcohol, and heated in a sealed tube, for some hours, at about 130°. The contents of the tube, which had nearly become solid, were dissolved in water, next treated with ether, and, after more purifying, a substance was obtained yielding, on elementary analysis, results leading to the formula $C_2H_7NO_2$. The remainder of this paper is devoted to a lengthy theoretical discussion on the various methods to ascertain the true nature of *substituted* ureas.

Condensed Ureas.—M. Schiff.—The author describes, at great length, a number of compounds which he calls *condensed ureas*, and which are made up according to the general formula—

$$XCH_4N_2O+(X-1)CnHmO-(X-1)H_2O.$$

Since this paper is, *de facto*, an exhaustive monograph on this subject, it is difficult to give any furthur abstract of the details it contains.

Compounds of Ammonia and Sulphate of Zinc.—M. G. Müller.—The author gives the following results of analysis of compounds of sulphate of zinc and ammonia, percentically:—Oxide of zinc, 30·58; sulphuric acid, 30·18; ammonia, 25·65; water, 13·59. Formula—

$$1ZnO1SO_34NH_32H_2O.$$

Oxide of zinc, 26·91; sulphuric acid, 26·58; ammonia, 22·59; water, 23·92. Formula—

$$1ZnO1SO_34NH_34H_2O, \text{ or } \left(\begin{matrix}SO_3\\Zn\end{matrix}\right\}O_3,4NH_3\Big),4H_2O.$$

Recovery of Nitrate of Uranium from the Phosphate of Uranium, and on a Nitro-Phosphate of Oxide of Uranium.—M. Heintz.—Since this paper bears upon a subject of importance to many chemists, and, since it is too lengthy for suitable abstraction, we intend to give it in full at a future period.

Chromate of Oxide of Zinc and Ammonia.—M. L. Bieler.—The author describes, at great length, the preparation of a salt composed, in 100 parts, of—Oxide of chromium, 33·01; oxide of zinc, 26·73; ammonia, 22.44; water, 17·82. This salt is readily soluble in dilute acids, crystallises, is decomposed by water, exhales ammonia constantly, and is, hence, readily and spontaneously decomposed.

Behaviour of Boracic Acid towards Oxide of Copper, Borate of Copper, and Ammonia.—M. Pasternack.—After reviewing the labours on this subject by MM. Tünnermann and Rose, the author records some experiments made by him in order to settle what compound is formed when a solution of two parts of sulphate of copper, and a solution of one part, by weight, of borax, are mixed, care being taken to pour the latter solution into the former. The mixture was next heated, filtered, and washed with warm water, whereby all the boracic acid was eliminated, and a salt left containing, in 100 parts—Sulphuric acid, 18·65; oxide of copper, 64·65; water, 16·79. To the filtrate obtained was added a fresh quantity of solution of borax, and a salt obtained containing, percentically—CuO, 52·72; B_2O_3. 18·59; H_2O, 28·69. A combination of boracic acid, ammonia, oxide of copper, and water, a true basic salt, had the following percentical composition:—CuO, 20·80; B_2O_3, 35·41; NH_3, 17·20; H_2O, 27·31.

Borate of Zinc and Ammonia.—M. Büscher.—This paper is analogous to the foregoing. The borate obtained consists, in 100 parts, of—ZnO, 20·40; B_2O_3, 35·27; NH_3, 17·13; water, 27·20.

Action of Acids upon Carbylamines.—This paper is not well suited for useful abstraction.

Synthesis of Paramonochlorobenzoic Acid.—M. C. Müller.—The acid just named is obtained in large quantity by the oxidation of chloride of benzol, after having been purified and dried over sulphuric acid. Paramonochlorobenzoic acid is a solid, fusing at 235°, readily soluble in alcohol and ether, but very difficultly soluble in water. Formula, $C_7H_5ClO_2$. Its baryta salt crystallises readily.

New Mode of Formation of Ethylsulphuric Acid.—M. Heusser.—By means of the action of sesquichloride of sulphur upon alcohol, and simultaneous exclusion of oxygen, the author has succeeded, by a method described at great length, in obtaining a baryta compound $(C_2H_5)Ba''S_2O_5(OH_2)_2$, which is ethyl-sulphate of barium. The paper discusses, at great length, the labours of MM. Carius, Warlitz, and others on this subject.

Nitride of Boron.—M. Darmstadt.—The author finds that this compound of boron and nitrogen can be readily obtained when one part of previously fused and powdered boracic acid, and about two parts of urea, are mixed and heated in a covered porcelain crucible, first more gently, at last to red heat. The fused mass is lixiviated with hot water acidified with a few drops of hydrochloric acid, in order to promote the deposition of the nitride of boron.

Journal de Pharmacie et de Chimie, August, 1869.

This number contains the following original papers:—

Magnetic Oxide of Iron and its Salts.—M. Lefort.—After briefly referring to the labours of M. Fourcroy, and other chemists of comparatively older date, the author describes, at some length, the preparation of the ferroso-ferric oxide of iron in the following manner:—100 grms. of pure sulphate of protoxide of iron is dissolved in a small quantity of distilled water previously freed, by long-continued boiling, from all air; 200 grms. of the same salt are placed in a suitable vessel, containing already 50 grms. of nitric acid and 50 grms. of water. This mixture is heated in a sand bath, until the whole of the sulphate of iron is peroxidised, and a dark brownish red liquid is obtained, which, after having become quite cold, is added to the solution of 100 grms. of sulphate of iron. The author next proceeds to make a boiling concentrated solution of either caustic potassa or soda, and, while this is kept boiling, the mixed solution of iron salts is cautiously added, drop by drop, to the alkaline liquid. In this manner a very beautiful magnetic oxide of iron is obtained, which, on account of its great density, is easily washed with previously well boiled, and still hot, distilled water. After washing, it should be carefully dried over sulphuric acid. After having been thus well dried, the author

found, on analysing it, that its composition corresponds to the formula $FeO+Fe_2O_3+HO$. When dried by means of heat, gradually applied, the water is eliminated, and oxidation at the same time sets in; and when the substance is entirely dry, it is, also, entirely converted into Fe_2O_3. The quantity of water contained in the air dried (over sulphuric acid) magnetic oxide, amounts to 7·20 per cent. The composition of the chloride of this magnetic oxide, a perfectly well-defined salt, is, in 100 parts:—Chlorine, 36·57; iron, 21·66; water, 41·77. Formula, $4Cl3Fe18HO$; or—

$$4Cl\left\{\begin{matrix}Fe\\Fe_2\end{matrix}\right\}+18HO.$$

The author has also succeeded in obtaining a sulphate; but the stability of these salts is, after all, very slight.

Synthesis of Phenol.—M. Berthelot.—The author has combined acetylen with fuming sulphuric acid, thereby forming acetylenosulphuric acid, which is not decomposed even by boiling water. The author has next prepared acetylenosulphate of potassa; and, on decomposing this salt, phenol was obtained in large quantity. Acetylenosulphuric acid should not be confused with acetylsulphuric acid, which is a totally different body, and readily decomposed, even by cold water.

Utility of Common Salt as Applied to Agriculture.—M. Peligot.—This lengthy paper is chiefly written with the view of criticising a paper published some time ago by M. Velter, "On the Utility of Common Salt to Agriculture, in consequence of its Ulterior Transformation into Carbonate, and, lastly, Nitrate of Soda." The chief result of M. Peligot's researches is, that when common salt naturally occurs in an arable soil, some plants assimilate this salt, but the greater number leave it unassimilated.

Milk met with in Algeria.—M. Commaille.—This paper contains the results of a series of analyses of milk from cows, goats, and sheep, taken at different periods after the birth of the young of these animals, while care is taken to ascertain the various races these different beasts belong to. Goat's milk, general average—Butter, 45·25; caseine, 35·34; lactine, 49·32; lactalbumine, 8·27; lacto-proteine, 1·90; ash, 7·77. Sheep's milk—Butter, 53·75; caseine, 41·85; lactine, 44·94; lactalbumine, 11·30; lacto-proteine, 3·16; organic acids, 4·63; ash, 9·22. The chief result the author points out is, that the milk in Algeria is better, that is to say, richer, especially in nitrogenised compounds, than the milk met with in Normandy and the Elsas.

On a Milk Mushroom (Champignon).—M. Hesling.—The author points out that, even long before milk becomes sour, there are generated in it very small organised spores of an *ascophora* species.

Annalen der Physik und Chemie, von Poggendorff, No. 8, 1869.

This number contains the following original papers and memoirs:—

Researches on the Impact of a Jet of Water.—Dr. Buff.—This is a very lengthy physico-mechanical essay, not bearing in any way upon chemical science. The makers of fire engines will find much interesting matter in this paper.

Limits of Magnetisation of Iron and Steel.—Dr. von Waltenhofen.—A monograph on this subject, the contents of which are entirely of a mathematico-physical nature.

Some Double (Tisin) Crystals of Sulphuret of Iron (Iron Pyrites).—Dr. Hessel.—This is a purely crystallographical essay on the subject, illustrated by a series of engravings.

Regular Cavities which Naturally Occur, or may be Artificially Produced on the Planes of the Crystals of Quartz.—Dr. J. Hirschwald.—Also a purely crystallographical essay, illustrated by several engravings.

Researches made for the Purpose of Determining the Electromotoric Force between Water and some Metals, by means of the Galvanic Compensation.—Dr. E. Gerland.—A mathematico-physical essay.

Meaning of Insulators in the Theory of Electricity.—M. Schwedoff.—This is the continuation of a lengthy monograph on this subject commenced two volumes previously; it is entirely a mathematico-physical essay.

Transversal Magnetismus of Iron and Steel.—Dr. E. Villari.—A very lengthy monograph, very concisely written, and purely mathematico-physical in its contents.

Researches on the Behaviour of Vapours towards the Law of Marriotte.—Dr. Herwig.—The second part of an extensive monograph on this subject, too lengthy and too abstrusely written to be fit for abstraction.

Meteorite of Krahenberg, near Zweibrucken.—M. E. Weiss.—This paper does not contain anything new on this subject, of which we gave an abstract of a paper taken from a previous number of this periodical (Chemical News, vol. xx., p. 83, *Am. Repr. Oct.* '69, page 244).

Observations of Solar Protuberances.—M. Zöllner.—We regret that we cannot extract this paper, as it is copiously illustrated with ten very beautifully executed coloured engravings, which are absolutely required for the proper understanding of the subject.

Evolution of Heat Caused by the Emission of Sound from Solid Bodies.—M. E. Warburg.—A purely physical essay.

American Journal of Pharmacy, September, 1869.

We learn from this number of the death of Prof. H. E. Dussauce, which took place at New Lebanon, Columbia County, N.Y., on the 20th of June last. The deceased, who was born on the 25th of December, 1829, at Paris, was a pupil of Chevreul, and was for a time one of the Professors of Industrial Chemistry in the Ecole Polytechnique. The deceased occupied the position of chemist in Tilden and Co.'s Laboratory, and was one of the editors of the *Journal of Applied Chemistry*, and the editor of several other works. The deceased was well known in Europe as an eminent technologist and an excellent analyst.

This number contains the following original papers and communications on subjects of scientific interest for chemists. We omit some papers relating to the practice of pharmacy, of which it should be said, however, that they highly deserve the attention of those concerned:—

Critical Note on Permanganate of Potassa as a Test for Distinguishing Chlorine, Bromine, and Iodine.—Mr. G. Macdonald.—The author has investigated this subject carefully, and made a series of experiments, the main results of which are, that this method of distinguishing, by means of the reaction produced by permanganate of potassa, between the three haloids above named, is only applicable to very dilute solutions, and, even then, care must be taken that the permanganate of potassa is also in very dilute solution, and added drop by drop, as any excess beyond what the iodide or bromide would decompose would be apt to give the liquid its own characteristic tint. Moreover, the method is applicable to simple solutions of haloid salts, and its use implies some previous knowledge by the operator, both of the composition and the strength of the solution under examination. In a compound solution of a chloride and iodide, this test, *per se*, would be of but little use, as only the presence of the iodide would be indicated, and recourse to other methods would be necessary for the detection of the chloride. In a solution containing no haloid whatever, as, for example, a solution of a nitrate or a sulphate, this test would indicate the presence of a chloride—that is, no change would be produced on the addition of the permanganate. In a solution containing organic matter, the test would, in many instances, be rendered worthless, since the permanganate is readily decomposed by such substances, with changes very similar to those produced by the action of iodides or bromides.

Sulphur in Louisiana.—The Louisiana Petroleum Company, while boring for oil near Lake Charles, reached, at a depth of 442 ft., strata of crystallised sulphur, some 2 ft. thick, and of very pure quality. On boring farther downwards, the auger passed, for a distance of 50 ft., through limestone rock, which yielded about 50 per cent of sulphur, with occasional strata of 6 to 8 feet in thickness of pure sulphur. The boring has now reached to a depth of 600 ft. The Company intend to begin mining operations for the extraction of sulphur, but the cost of such work cannot fail to be very large; yet it appears that there is so great a demand for sulphur in the States that mining it at this depth will pay.

Zeitschrift für Analytische Chemie, von Dr. C. R. Fresenius, second number for 1869.

This number contains the following original memoirs and papers:—

Preservation (Storing) of Solutions of Protochloride of Tin, Sulphuretted Hydrogen, and the like.—Dr. F. Mohr.—The keeping of large quantities of titrated solutions is what is meant by the author, who advises that such solutions, after having been made in large quantity, should be poured in bottles provided with a tubulure at the bottom, through which a perforated cork, into which a downward-bent glass tube is fitted, and that this tube should be connected with another longer tube, by means of india-rubber fittings, and so arranged as to admit of running fluid into a burette; the neck of the bottle is fitted with a perforated cork, wherein a narrow glass tube is inserted. In order to prevent the action of the air upon the fluid contained in the bottle, a layer of petroleum, 1 centimetre high, is poured on the fluid. Saturated aqueous solution of sulphuretted hydrogen may be preserved in the same manner; but the bottle containing it should be kept in a cool place, and not exposed to direct sunlight.

Analysis of Ferromanganese.—M. Darmstadt.—Ferromanganese is a peculiar variety of iron which contains a large quantity of manganese. The general plan of analysis followed in this instance by the author is the same as that published in Fresenius's last edition of "Qualitative Analysis;" the estimation of the carbon was made by Berzelius's method, dissolving the iron in neutral chloride of copper. The result of the analysis quoted, percentically, is:—Iron, 73·474; manganese, 21·064; cobalt, 0·007; zinc, 0·062; copper, 0·072; lead, 0·011; aluminium, a trace; titanium, 0·011; calcium, 0·175; magnesium, 0·035; arsenicum, 0·001; antimony and tin, 0·030; phosphorus, 0·109; sulphur, a trace; silicium, 0·059; carbon, 4·805.

Separation of Oxide of Uranium from Phosphoric Acid.—M. Reichardt.—The author refers to the separation of phosphoric acid from oxide of uranium where the latter is used in large quantity for the estimation of phosphoric acid. Dissolve the phosphate of uranium in hydrochloric or nitric acids, apply heat, add excess of chloride of iron, and, next, excess of solution of carbonate of soda; wherein, aided especially by the large quantity of carbonic acid which is thus set free, the oxide of uranium is readily dissolved, while the phosphoric acid is combined with the oxide of iron. The solution of oxide of uranium in carbonate of soda is acidified with hydrochloric acid, boiled to expel carbonic acid, and the oxide of uranium next precipitated with ammonia.

Estimation of Organic Matter and Nitric Acid in Well Waters.—M. Reichardt.—This paper is chiefly a review, criticising the value and reliability of a number of methods for the quantitative estimation of organic matter and nitric acid in potable water. From this paper we incidentally learn that the water of the well of the house, No. 42, Gerichtstrasse, Berlin, contains, in 1 litre, 0·675 grm. NO_5. The average of twenty-seven different samples of well-water of Leipzig is 0·346 grm. to the litre. The water of the waterworks of Leipzig contains 11·5 parts of NO_5 in 1,000,000 parts of water.

Modification of the Piknometer.—Dr. Gintl.—Since, without the woodcuts annexed to this paper, its contents could not be clearly understood, we only quote the title.

Estimation of Phosphoric Acid in the shape of Pyrophosphate of Magnesia.—Dr. Kubell.—This paper is a concisely written treatise, divided into two sections—the first of which treats of the solubility of the ammoniacal phosphate of magnesia in water containing ammonia; the other section treats of the precipitate caused, in an ammoniacal solution containing phosphoric acid, by excess of solution of magnesia. This treatise does not admit of suitable and useful condensation.

Changes Albuminates Suffer when they are Submitted to the Action of Water.—Dr. W. Schmidt.—Albumen, prepared from serum of blood, casein, fibrin, and other similar materials, were submitted, in sealed tubes, to the joint action of a high temperature, ranging from 135° to 150°, and water, in order to test the correctness of M. Meissner's statement that these materials yield, when so treated, peptones. This, however, is not the result of the author's researches, which have not brought to light any other results than those generally known on this subject.

Improvement of the Volumetrical Estimation of Copper and Zinc contained in Ores by means of a Standard Solution of Ferrocyanide of Potassium.—M. Galetti.—This paper is reserved for full translation.

Description of an Improved Apparatus for the Evolution of Sulphuretted Hydrogen.—Dr. Seelhorst.—Without the engravings annexed to this paper it cannot be well understood.

Peculiar Appearance Shown by the Flame of Burning Hydrogen.—Dr. Seelhorst.—The author has repeated Barett's well-known experiments of holding in the flame of burning hydrogen gas very well cleaned glass rods, metals recently cleaned by filing them just previous to the holding in the flame, and has observed the same blue colouration as M. Barett did. But the author is not at all inclined to ascribe this colouration to the effect of burning sulphur, which should be so generally spread about in the shape of some sulphate, as to produce this colouration. The author, though abstaining from stating any precise cause at all, inclines to the belief that the cooling effect of the cold body held in the flame has something to do with this phenomenon. Perfectly pure hydrogen, burning from a platinum burner, as well as from iron or glass burners, exhibited the phenomenon, when cold bodies, just after having been cleaned by scraping or filing, were held in that flame. These experiments were conducted in a laboratory, repeated in a lecture-hall, and in the tap-room of a *café* with the same result.

Estimation of Lime and its Separation from Magnesia when Dolomites are to be Analysed.—Dr. A. Cossa.—The author's object has been to determine what the accuracy is of estimating lime as quicklime or caustic lime, instead of weighing it as carbonate of lime. The experiments were made—(1) With pure oxalate of lime previously dried at 100°; (2) with carbonate of lime precipitated from a solution of pure chloride of calcium by means of pure carbonate of soda; (3) with pure, native carbonate of lime, Iceland spar. The result of an average of three experiments with No. 1 is 0·07 per cent too low; with No. 2, 0·35 per cent too low; with No. 3, 0·27 per cent too high. As regards the analysis of dolomite, the author states that, when care is not taken to re-dissolve the precipitate of oxalate of lime first obtained and re-precipitate this a second time, it is always so contaminated with oxalate of magnesia or ammonio-oxalate of magnesia, that the quantity of lime found as carbonate may be 0·62 per cent in excess of what it ought to be, while the loss for carbonate of magnesia may even be as high as 0·78 per cent.

Analysis of Soft Lead.—Dr. Fresenius.—This paper or treatise is an exhaustive monograph on the analysis of refined lead and the estimation therein by volumetrical methods of iron, copper, zinc, antimony, and other metals. This treatise, as may be expected from the eminent author, is as complete as can be desired, but it is too lengthy and too concisely written for useful abstraction.

Comparative Researches on the Estimation of Phosphoric Acid.—M. Kissel.—The author treats on the gravimetrical and volumetrical methods in use for the estimation of this acid. (*a*) Direct estimation as pyrophosphate of magnesia; average result of three carefully conducted experiments, 99·53 per cent; result by the same method, but with the correction required for the solubility of the ammonio-phosphate of magnesia in ammoniacal water, average of three experiments, 100·22 per cent. (*b*) Indirect estimation as pyrophosphate, following a previous precipitation as molybdophosphate of ammonia; average result, without correction for solubility of ammonio-phosphate of magnesia, 99·09 per cent, with that correction, 99·79 per cent; estimation (gravimetrical) as phosphate of oxide of uranium; average result, 100·33 per cent; estimation as basic phosphate of iron; average result, 99·68. Volumetrical methods: Average result of four experiments with acetate of oxide of uranium, 100·12 per cent. The author has purposely made a series of experiments in order to ascertain the influence of repeated solution and re-precipitation of the ammonio-phosphate of magnesia, obtained in quantitative research, also the influence of excess of ammoniacal salts and the action of dilute ammonia upon pure ammonio-phosphate of magnesia, the results obtained do not materially differ from what is generally known on this subject and published thereon in works on analytical chemistry.

Application of the Principle of Areometry to Quantitative Chemical Analysis.—Dr. Gintl.—The plan devised by the author is extremely ingenious, and deserves the attention of analysts; but we cannot condense his paper or make the principle even understood without the reproduction of some engravings absolutely necessary for the explanation of the subject.

Detection of Bitter Substances other than Hops in Beer.—M. L. Enders.—In order to separate lupuline from quassiine, absynthiine and menyanthine, the author proceeds as follows:—Alcohol is applied to separate gum, a mixture of strong alcohol and ether to separate sugar from beer; the solution of bitter substances is next treated with acetate of lead; a precipitate ensues which contains lupuline and hop-resin; treat precipitate with H_2S, separate PbS, wash with alcohol, evaporate the filtrates to dryness, exhaust the residue with chloroform, and repeat this operation, adding a large quantity of warm water; evaporate chloroform when the hop-resin is left as an insoluble matter in the water, which, after separation of this resin, is also evaporated to dryness; the residue has a bitter taste; exhibits when dissolved in water, an acid reaction to test paper; is soluble in alcohol, ether, and chloroform; the weak alcoholic solution is precipitable by acetate of lead, but not by tannic acid; does not give, when treated with ammoniacal silver-solution, a deposit of metallic silver. These characters indicate lupuline. The filtrate from the solution above alluded to is freed by means of H_2S from excess of lead, the sulphide of that metal removed by filtration, the filter washed with hot water, and the filtrate heated in order to expel sulphuretted hydrogen gas; and next, a solution of tannic acid is added; in case a precipitate ensues, it is collected on a filter, some pure carbonate of lead is added to the precipitate while yet wet, and the mass is dried, next boiled with alcohol, the filtrate therefrom evaporated to dryness and exhausted with pure ether. This ethereal solution is evaporated to dryness, the residue is either soluble in alcohol, or in a large quantity of hot water, the aqueous solution is precipitable by means of tannic acid, not by acetate of lead; the precipitate is first mixed with concentrated sulphuric acid, and, on addition of some water, yields a bluish violet colour. The substance boiled with ammoniacal solution of silver yields a metallic mirror: these characteristics indicate absynthiine. The residue insoluble in ether is soluble in alcohol; this solution, after having been diluted with water, is precipitable by tannic acid, not by acetate of lead; the substance on being heated with ammoniacal solution of silver yields a metallic mirror, indicating menyanthine; absence of metallic mirror indicates quassiine.

Cosmos, September 4, 1869.

Origin of the Alkaline Chlorides found in the Water and Rocks of the Coal-Formation of Luijk, Liege (Belgium).—M. Malherbe.—After referring to the doubts existing about the question whether the plants which have given rise to the coal-fields have been submerged by fresh or salt water, or by a mixture of both, the author contends that, as far as the coal-basin above named is concerned, his opinion is that the plants which served to form the coal were submerged in a mixture of fresh and salt water, since not only the water pumped up from the pits in the locality mentioned contains a large proportion of alkaline chlorides, but the rocks in that part of the country also contain a considerable quantity of these salts. The author's opinion is not shared by the well-known eminent Belgian geologist, M. Omalius d'Halloy, who states that coal has been formed in a similar manner as peat is at the present day, in stagnant fresh water; but the presence of the alkaline chlorides is accounted for, by later irruptions of the sea, and by the many commotions the coal formations have been subject to long after they were formed.

Revue Hebdomadaire de Chemie, September 2, 1869.

This number contains an excellent description of—

The Freezing Apparatus Invented by M. Toselli.—The author applies freezing mixtures made up without the addition of acids, and chiefly prefers the following salts:—Nitrate of ammonia, carbonate of soda, sal-ammoniac, and chloride of potassium, mixed in certain quantities together. The mixture best adapted for his apparatus is made up of equal parts of nitrate of ammonia, carbonate of soda, and water, wherewith a lowering of temperature of —33° can be obtained. Without the reproduction of the woodcuts annexed to this paper, it would be useless to try to describe the apparatus applied by the author, who conducts, at Paris, a business on a large scale, for the artificial production of ice, and the sale and making of his apparatus and the salts used for the production of cold. According to all accounts, his invention is the best and most applicable of the kind hitherto made.

Les Mondes, September 9, 1869.

The Deepest Artesian Well in the World.—If the American reporter of this periodical is well informed there exists at Saint Louis, U.S., an artesian well, which, as far back as the year 1854, had been bored to a depth of 2199 feet, without reaching water bearing strata. In 1865, the previously suspended borings were resumed, and are yet pushed forward; but though a depth of 2852 feet has been reached, no water bearing strata has been found. The borings now proceed only about three inches depth every day, in compact solid granite, and the cost per month amounts to 1600 dollars.

Comptes Rendus des Séances de l'Académie des Sciences, September 27, 1869.

This number, an unusually thin one, opens with a brief but very touching speech of M. Dumas, announcing the demise of the late Master of the British Mint, who was a corresponding member of this institution. The eminent speaker dwelt for a few moments on the great scientific merits of the de-

ceased, pointing out his discoveries and researches, and expressing regret at the loss of such an eminently distinguished *savant*.

The following are the original papers and memoirs relating to chemistry contained in this number:

Action of Permanganate of Potassa upon Asparagine.—M. Campani.—Asparagine is converted, by the action of water alone, into aspartate of ammonia. According to this author, asparagine is converted, by the oxidising action of permanganate of potassa, into ammonia, oxalic acid, carbonic acid, and a trace of hydrocyanic acid.

The Vacuum as a means of Preventing Explosion in Coal-Pits.—M Ruffard proposes that, on Saturday evenings, all the shafts of a coal-pit, one only excepted, shall be hermetically closed, and that that shaft shall be put into communication with an air pump, which, on withdrawing the air, will cause the marsh gas, fire-damp, freely to issue from the pores of the coals, and thereby cause a thorough cleansing of the air of the pit. It is very difficult to imagine that such a proceeding will have any really useful effect.

New Hygrometer.— M. Crestin.—The author proposes to place, on the plate of an areometer, a quantity of perfectly dry common salt; the areometer is then placed in pure water, which is covered by a layer of oil. While the salt absorbs moisture, the areometer gradually sinking into the water indicates the degree thereof.

Chinese Industry.—M. Champion.—The author has published a work on the ancient and modern industries of the Chinese Empire. This work is highly spoken of by M. Dumas, who points out that the Chinese excel Europeans in many matters.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 13, 1869.

From the proceedings of the meeting of this Society, held under the presidency of Dr. A. W. Hofmann, on the 12th of July last, and recorded in this number, we find, among the foreign gentlemen elected members of this Society, the names of Prof. Abel, of Woolwich; Dr. E. H. Kinson, Sandhurst, Farnborough; and Dr. W. Odling. The following papers and communications were read:—

Constitution of Tourmalin.—M. C. Rammelsberg.—In the introduction to this essay, the author points out the difficulties which beset this subject, which has frequently been worked at by various mineralogical chemists; but notwithstanding the author himself made a large number of analyses of this mineral, several points of interest were not clearly elucidated, among these—(1) The behaviour of tourmalin on ignition; (2) the degree of oxidation of iron, forasmuch as this metal occurs in this mineral, which is not the case with all varieties thereof; (3) the precise quantity of boron contained in tourmalin. Tourmalin is a very complex mineral; it contains the following elements:—H, K, Na, Li, Fl, Mg, Ca, Mn, Fe, O, Si, B, and Al. Tourmalines are found not containing Li, Fe, Mn, or Ca. The colourless, or pale red-coloured tourmalin, from Elba, contains 0·2 per cent of MgO; a brown variety, from Windischkappel, contains 11·8 per cent MgO; the black tourmalin, from Andreasberg, contains 17·4 per cent FeO. Magnesia tourmalines are yellow or brown-coloured; the magnesia-iron tourmalines are dark brown or black-coloured; iron tourmalines are quite black-coloured; and the tourmalines which do not contain any iron at all; but manganese, are rose or pink-coloured, or sometimes even colourless. As regards the fundamental composition of this mineral, it is a tri-silicate—

$$\overset{I}{R_6}SiO_5—\overset{II}{R_2}SiO_5—\overset{VI}{R}SiO_5.$$

The author proceeds at length, enumerating the various species of this mineral, according to the prevalence therein of certain elements; but, strictly speaking, this portion of his paper rather belongs to mineralogy, and our space, moreover, forbids us to quote the large number of formulæ required to elucidate this subject.

On Chloral.—MM. Martius and Mendelssohn-Bartholdy.—The authors state that they have been induced to try whether it would not be possible to prepare chloral in large quantities, so that if this substance should become used in pharmacy, it could be obtained in a pure state. The hydrate of chloral would, according to the authors, answer this purpose by far the best. This hydrate ought to be a white crystalline mass, endowed with considerable hardness; it should dissolve readily in water, and be devoid of any smell of chloride of carbon or hydrochloric acid, while it should exhibit its peculiarly strong smell. The authors exhibited at this meeting several pounds' weight of chloral, and stated that they hope shortly to be able to exhibit to the members of this Society the synthesis of chloroform by an easily executed method, as also trichloracetic acid, made according to M. Liebreich's method.

On Euxanthon.—M. A. Baeyer.—According to the researches of the late Prof. Gerhardt, the euxanthon, obtained by M. Erdmann from the euxanthinic acid contained in Purrhee, should be composed according to the formula $C_{16}H_8O_5$. The author found that, when vapours of euxanthon are passed over powder of zinc heated in a combustion tube, there is formed a semi-solid hydrocarbon, resembling diphenol; and he concludes, hence, that euxanthon is not a derivative from naphthaline, but has to be referred to a benzole containing four atoms of carbon in a peculiar form. The author, on treating euxanthon with bichromate of potassa and sulphuric acid, did not succeed in obtaining products of oxidation of euxanthon, since the reaction became too violent; but, on fusing euxanthon with caustic potassa, a new substance was obtained, which the author calls euxanthonic acid, $C_{13}H_{10}O_5$. It is a weak acid, which yields, with basic acetate of lead, a reddish yellow-coloured precipitate; with chloride of iron, it yields a red colouration; euxanthon, on the contrary, yields, with that reagent, a green colouration. Euxanthonic acid is far more readily soluble in water than euxanthon.

Synthesis of Picolin.—M. Baeyer.—When acrolein-ammonia is submitted to distillation, an aqueous ammoniacal fluid and a basic oil are obtained. M. Claus discovered that the double salt of platinum of that base possesses the same composition as the picolin platinum salt, $NC_6H_6Cl.PtCl_2$; but the properties of that salt do not at all remind one of picolin. The author of this paper found that the aqueous ammoniacal fluid, which has not been investigated by M. Claus, contains a large quantity of picolin, and this picolin exhibits the very identical properties possessed by the picolin obtained from coal-tar and bone distiller's tar. The author explains the origin of picolin in the following manner:—Fatty substances yield acrolein, and, under the joint influences of ammonia and a high temperature, picolin is formed, according to the following formula:—

$$2C_3H_4O + NH_3 = NC_6H_7 + 2H_2O.$$

Derivatives from Naphthaline.—MM. Darmstädter and Wichelhaus.—The authors continue in this paper the communication of the results of their experiments on this subject, and describe, at great length, how they succeeded, by a very complex process, in obtaining bicyanaphthaline—

$$C_{10}H_6\begin{cases}CN\\CN\end{cases}$$

This substance exhibits needle-shaped pale yellow crystals, difficultly soluble in alcohol and ether, insoluble in water, and fusing at 204°. From this substance, the authors have prepared a compound which they call bicarbonaphthalinic acid—

$$C_{10}H_6\begin{cases}CO.OH\\CO.OH\end{cases}$$

This substance is a solid crystalline material, very difficultly soluble in boiling water, soluble in alcohol, not fusible nor

decomposed at 240°. The authors refer, in this paper, to three varieties of bicyanaphthaline, in addition to the substance of that name already alluded to, and each obtained from a different naphthaline compound.

Action of Fusing Hydrate of Potassa upon Stearolic Acid.—M. S. Marasse.—The author, after referring to the labours of Messrs. Frankland, Duppa, Overbeck, and others, on this subject, states that stearolic acid is not a substituted acrylen, but that the molecule of this acid contains twice the group C=C. Acting upon this idea, the author has succeeded in so managing the action of the fusion with hydrate of potassa as to obtain from stearolic acid a homologue of acrylic acid. The new acid thus obtained is a colourless fatty matter fusing at 21°; its formula is $C_{16}H_{30}O_2$.

Constitution of Benzol.—M. A. Kekulé.—Unless we reproduce the woodcuts annexed to this paper, and essential to its proper elucidation, we cannot usefully give an abstract of it.

Crotonaldehyde.—M. A. Kekulé.—This paper contains the results of a series of experiments, made with the view to prove, experimentally, the mode of the combination of the atoms of carbon in benzole. The paper is too lengthy, and so crowded with formulæ, that it is impossible to give a proper abstract of it.

Lecture Experiments.—M. Kessler.—No. 1. Ignition of a mixture of H and Cl by means of the flame of CS_2 burning in NO, is rather awkward to manage. The author uses the magnesium light for that purpose. After having fastened a bottle filled with H and Cl to a retort stand, a piece of magnesium ribbon is taken hold of with a pair of forceps, ignited in the flame of a spirit-lamp, and moved, close to the bottle, up and downwards. A slight shock indicates the end of the reaction. The bottle is next opened under water.—No. 2. When burning magnesium wire is placed in a vessel containing CO_2, the latter is decomposed, and carbon deposited. Some HNO_2 should be poured into the vessel at the end of the reaction, in order to dissolve some magnesia resulting from the combustion, and to make the deposit of C distinct. —No. 3. Water having been poured into a rather wide-mouthed flask, it is made to boil as briskly as possible. When, after this boiling has been continued for some time, previously-ignited magnesium wire is held deep down in the mouth of the flask, it continues to burn. The same metal burns with great brilliancy in N_2O and NO, also in H_2S and SO_2, but is extinguished by CO. The floating of soap bubbles upon CO_2 is exhibited with the least expenditure of that gas, when it is made to pass through the narrow neck of a large glass funnel.

On Diazocyanbenzol.—M. P. Griess.—This paper contains a first instalment of the results obtained when experimenting on the products of decomposition of diazocyanbenzol. Among these, the author found diazocyanbenzolimid —

$$\left.\begin{matrix}[C_6H_3(CN)N_2]''\\ H\end{matrix}\right\} N + 3NHBr.$$

This substance is a solid body, almost insoluble in water; readily soluble in warm alcohol; crystallizing, from the solution in that fluid, in large needle-shaped, bright yellow-coloured crystals: fusing at 57°, and exploding when more strongly heated. Iodinecyanbenzol, also a solid substance, insoluble in water, readily soluble in alcohol and ether, and fusing at 41°.

Some Derivatives from Anethol.—M. Ladenburg. —After referring to his former researches on this subject, the author states that he has succeeded in obtaining anol, a solid substance, fusing at 92·5°; soluble in alcohol, ether, and chloroform; and boiling at 250°. Formula, $C_9H_{10}O$. Chloranethol is a somewhat yellowish-coloured fluid which solidifies at a low temperature, and becomes fluid at —6°; boils at 257°; sp. gr., 1·1154. When this body is treated with caustic potassa, and heat applied, there is formed a substance, $C_{10}H_{10}O$; it is a liquid insoluble in water, and boiling at about 242°.

Chrysophanic Acid.—M. Rochleder.—When this acid is distilled along with powdered zinc, anthracen is formed. After this statement, the author proceeds to discuss the formula which chrysophanic acid ought to have, and, having found that chrysophanic acid, dried at 100° (all analyses made of this substance have been made with quantities thereof which were dried at that temperature), retains water, which can only be expelled at 115°, aided by a current of dry carbonic acid gas. The author ascribes to this circumstance the discrepance of the results of the elementary analyses made of this substance, and suggests that the formula of the acid dried at 100° should be written $4(C_{14}H_{10}O_4)+OH_2$. The author also found that chrysophanic acid made from rhubarb root is always contaminated with emodin; but this substance being soluble in a hot solution of carbonate of soda, wherein chrysophanic acid is insoluble, the two may be separated from each other in that manner. Emodin may be precipitated by acids from its alkaline solution, and, after having been carefully washed with water, may be dissolved in alcohol 80 per cent, and obtained in crystals on evaporation of that solution. Emodin exhibits an orange-yellow colour. The chrysophanic acid which has been separated, as described, from emodin, should first be well washed with water, and next repeatedly treated with boiling alcohol of 90 per cent, and thus obtained in pure state. So purified, the formula for dried chrysophanic acid is $C_{14}H_{10}O_4$.

On Naphthaline Red.—Dr. A. W. Hofmann.—At the Paris Exhibition of 1867, there was only one naphthaline color exhibited, to wit, the naphthaline yellow (dinitronaphthol) discovered by Dr. Martius. The author says that he has received, from his friend M. Scheurer-Kestner, a quantity of a very remarkable substance, now known as napthaline red on the continent, and in England designated Magdala red. This substance, as sent to Dr. Hofmann, exhibits a blackish brown, somewhat crystalline, powder, soluble in alcohol, yielding a deeply red-coloured solution, on evaporation of which greenish crystals endowed with metallic lustre are obtained; these crystals proved to be the chloride of a base which, on analysis, was found to be composed of $C_{20}H_{21}N_3$. The eminent author proposes to investigate this subject more fully, for which reason the brief account here given may suffice for the present, the more so as the manufacture of this napthaline red (first made at Bäsle, on the large scale) is as yet rather uncertain.

On Xylidine Red.—Dr. A. W. Hofmann.—When pure xylidine is treated with oxidizing agents, no red-coloured pigment is obtained; neither is this the case when, after having been mixed with toluidine, xylidine is treated as is done for the preparation of rosaniline; but when xylidine is mixed with aniline, and then treated with the agents used to make rosaniline, almost beautiful carmine red pigment is obtained which dyes wool and silk a very fine colour. The probable composition of this pigment is $C_{22}H_{22}N_2,H_2O$.

Contribution to our Knowledge of Chrysaniline.—A. W. Hofmann.—When a solution of pure chrysaniline in pure wood-spirit (methyl-alcohol) is mixed with iodide of methyl, and heated in a sealed tube, for about six hours, to 100°, a solid crystalline substance is obtained, which, after having been purified, may be dissolved in boiling water, from which solution beautifully orange-carmine red crystals are deposited, which constitute the diiodhydrate of trimethylchrysaniline, $C_{20}H_{14}(CH_3)_2N_2,2HI$; the solution of this salt dyes wool and silk a deep orange-yellow, verging upon scarlet-red. From this substance, on being treated, when in solution, with ammonia, the monoiodhydrate of trimethylchrysaniline is obtained—

$$C_{20}H_{14}(CH_3)3N_2,HI.$$

Trimethyl-chrysaniline yields, with acids, very well-defined salts, which are rather readily soluble in water, excepting the nitrate and picrate. Chrysaniline behaves with iodide of ethyl as it does with iodide of methyl.

Porphyritic Rocks of Austria.—M. G. Tschermak.—The Vienna correspondent of this Society, M. Ludwig, writes to the effect that the author named at the heading of this paragraph has made a series of researches on augite and amphibole. The former mineral, if crystallised, is a combination of $MgCaSi_2O_4$ and the therewith isomorphous $FeCaSi_2O_4$. Augite, which is imbedded in rocks, contains alumina, and, moreover, a silicate made up according to the formula, $MgAl_2SiO_4$. The composition of amphibole is rather more complex, because it also contains a soda silicate.

On Benzylic Acid.—M. A. Jena.—When benzile is heated with an alcoholic solution of caustic potassa, benzylic acid is formed, and also benzoic acid. Benzylic acid is formed more readily when benzile is heated with water in sealed tubes. Pure benzylic acid fuses at 150°; moistened with concentrated sulphuric, it becomes red-coloured; heated for some length of time to 180°, it yields a red-coloured resin, and a compound, $C_{28}H_{22}O_5$. When benzylic acid is treated with dilute sulphuric acid and bichromate of potassa, water, carbonic acid, and benzophenon are formed—

$$\underbrace{C_{14}H_{12}O_3}_{\text{Benzylic acid.}} + O = H_2O + CO_2 + C_{13}H_{10}O.$$

Formation of Adipinic Acid from Mucic Acid.—M. L. Marquardt.—The author says—"Some time ago M. Bode succeeded in obtaining from the compound $C_6H_4Cl_2O_4$ (which compound is the result of the action of excess of phosphor-chloride upon mucic acid), by means of zinc or sodium amalgam, a substance which he (M. Bode) called muconic acid, $C_6H_6O_4$; this acid only differs from adipinic acid by a deficiency of 2H. The author of this paper states that he has obtained, from muconic acid, pure adipinic acid, by treating the former, after having been moistened with water, with sodium-amalgam, and leaving this mixture standing for some hours in a warm place. The fluid, after having been removed from the mercury, is acidified with dilute SO_3, next shaken up with ether, and, on removal of that fluid, by distillation, adipinic acid remains behind.

Annalen der Chemie und Pharmacie, September, 1869.

This number opens wih a series of three treatises on trimethyl-benzol. The first of these papers treats on:—

The Trimethylbenzol which is Formed by the Introduction of an Atom of Methyl into Xylol.—MM. R. Fittig and K. Laubinger.—In the introduction to this paper, the authors state that mesitylen is a peculiarly-modified trimethyl-benzol; and that the substance which, under the name of cumol, or pseudo-cumol, has been met with in coal-tar is also a modification of trimethyl-benzol, but different from mesitylen by its monobromide, $C_9H_{11}Br$, which is a crystalline substance, fusing at 73°. Pseudo-cumol has often been the subject of chemical researches; but the authors of this paper deny any value to these researches, since, according to them, pseudo-cumol, as applied to these researches and obtained from coal-tar, is and always remains, any rectifications and fractional distillations notwithstanding, a mixture of several hydrocarbons. The authors, therefore, have prepared pseudo-cumol synthetically, by introducing into xylol 1 atom of methyl. The fluid thus obtained was purified by distillation with sodium, and was found to boil constantly at 166°. *Products of substitution of pseudo-cumol.*—Mononitropseudocumol, $C_9H_{11}(NO_2)$, is a solid substance, crystallising in prisms, fusing at 71°, soluble in alcohol. It is distinguished from nitro-mesitylen by its point of fusion, and by its being soluble in cold-fuming nitric acid without thereby undergoing any change. Dinitropseudocumol has not been obtained by the authors in pure state. Trinitropseudocumol, $C_9H_9(NO_2)_3$; also a solid substance fusing at 185°, and crystallising from its solution in benzol in large quadratic-shaped prisms. The authors then treat, under the following heads, the following subjects:—*Products of reduction from trinitropseudocumol; bromated products of substitution from pseudocumol; products of oxidation of psuedocumol.* Among the latter, xylylic acid, $C_9H_{10}O_2$, is found; also paraxylylic acid, and xylydinic acid, $C_8H_8O_4$, which are described at great length, as well as their salts.

The second treatise on this subject is headed—

On the Trimethylbenzol which is Generated when Two Atoms of Methyl are successively introduced into Toluol.—MM. Fittig and Jannasch.—The authors say they have proved, by researches made and published some time ago, that the methyltoluol prepared synthetically from toluol differs from xylol; a difference undoubtedly due to the unequal position of the atoms of methyl towards each other. The authors therefore argue that, if, synthetically, a third atom of methyl be added to the methyltoluol (dimethylbenzol), a trimethylbenzol, different from pseudocumol will be obtained. In order to prove this hypothesis by experiment, they prepared from toluol a large quantity of methyltoluol; and, on treating that with bromine, obtained *monobromated methyltoluol*, $C_6H_3Br(CH_3)_2$, a liquid as clear and colourless as pure water, boiling at about from 204° to 206°. By means of iodide of methyl and sodium, trimethylbenzol was prepared from the liquid just alluded to. The result was the generation of a liquid boiling at 166°, and not differing in physical qualities from pseudocumol. In many of its chemical characters this trimethylbenzol is not distinguished from pseudocumol. The greater part of this paper is devoted to a discussion of the relative position of atoms of CH towards other groups of polymers thereof; but since, without the introduction of some woodcuts annexed to the original, this rather abstruse subject cannot be clearly understood, we proceed to the third treatise:—

On the Trimethylbenzol contained in Coal Tar.—MM. Fittig and Wackenroder.—The authors have prepared from the hydrocarbons of coal-tar (which have a high boiling point), by carefully conducted, often-repeated, fractioned distillation, a hydrocarbon, the boiling point of which lay between 164° and 167°. This material has been converted into a trinitro-compound, which, after having been purified, yielded a solid crystalline body, fusing at 230°, soluble in alcohol, and yielding, after carefully-conducted elementary organic analysis, results leading to the formula $C_9H_9(NO)_{23}$. On dissolving this substance in warm benzol, the authors found that the body alluded to is not a simple compound, since the mother liquor of the solution in benzol yielded, on evaporation (after the previous separation of the crystalline compound just mentioned), a batch of prismatically-shaped crystals, entirely different from the needle-shaped body first obtained, which last crystalline body was found to fuse at 185°, and to possess all the properties of trinitropseudocumol. The researches of the authors, very exhaustively described, lead to the result that the trinitro-compound obtained from the hydrocarbon from coal-tar above alluded to is a mixture of trinitromesitylen and trinitropseudocumol; accordingly the hydrocarbon from coal-tar boiling at from 164° to 167° is a mixture of pseudocumol and mesitylen, which latter substance may even be prevalent in this fluid.

Electrolysis of Water in Contact with Silver.—Dr. Ruuspaden.—This monograph treats on the fact first observed by Prof. Wöhler—that when water acidified with sulphuric acid is decomposed by a galvanic current, and silver is applied as electrodes, peroxide of silver is deposited on the anode and metallic silver on the cathode. The two main questions answered by the author by a series of experiments are—What is the cause of the formation of peroxide of silver on the positive pole, and by what means does the metallic silver find its way from the positive to the negative pole? The treatise is too lengthy and too concisely abstracted already in this periodical [the treatise was published originally as a separate work] to admit of useful condensation. In an appendix, the author informs us that there is an error

in all works treating on chemistry and physics, viz., the statement that gold (pure, of course) and platinum are the only two metals which are not oxidised at the positive pole when serving as electrodes. The author finds, and has confirmed by experiments carefully conducted, so as to exclude any source of error, that gold itself is oxidised to a very considerable extent, and that, during experiments as those alluded to, there is formed a definite oxide, $Au_2O_3,3H_2O$: percentically—gold, 79·47; oxygen, 9·62; water, 10·91.

On Chlorous Acid.—M. Brandau.—The author gives, in about twenty pages, a very complete and exhaustive treatise on the preparation and properties of chlorous acid, both as gas and as liquid. Since, however, the engravings added to this paper are absolutely required to understand a great part of it, we content ourselves by describing the properties of the liquid chlorous acid. It is a liquefied gas; colour of fluid, deep red-brown; very fluid. Even below 0°, the vapour of this liquid exerts a considerable pressure. Freshly prepared, the fluid boils about half a degree above 0°. If this fluid is suddenly brought to a temperature of about + 8° to 10°, it explodes with great violence. It cannot be kept without continuous and spontaneous decomposition for any length of time. The gas given off from this liquid exhibits the well-known greenish-yellow colour of chlorous acid. The specific gravity of the liquefied gas at 0°, referred to water at 4° (the point of greatest density of water), is 1·3298.

Preparation of Chlorate of Baryta.—M. Brandau.—The author makes a mixture of commercial sulphate of alumina, of sulphuric acid, water, and chlorate of potassa. The mixture should have the consistency of a thin magma, and be heated on a water-bath during half an hour, while it is frequently stirred up. The reaction which takes place is represented by the undermentioned formula:—

$$[Al_2(SO_4)_2] + SH_2O_4 + (ClKaO_3)_2 = [Al_2(SO_4)_2 + SKa_2O_4] + (ClHO_3)_2.$$

The product is a solution of hydrated chloric acid, alum, excess of sulphate of alumina, and excess of sulphuric acid. After the mixture has become quite cold, it is mixed with several times its bulk of alcohol, filtered, and washed with alcohol of 50 per cent. The alcoholic filtrate is neutralised with hydrate of baryta, whereby chlorate of baryta, sulphate of baryta, and some alumina are formed. The bulk of the alcohol is removed by evaporation. The aqueous solution of chlorate of baryta is next filtered, and the residue washed with water (distilled, of course). The liquid is next evaporated to crystallisation, yielding pure chlorate of baryta. A slight excess of sulphate of alumina and sulphuric acid should be applied, since, otherwise, some chlorate of potassa will remain mixed up with the chlorate of baryta.

The Brominated Products of Substitution of Dibenzyl.—Dr. Marquardt.—The author first refers to the researches made on this very same subject by MM. Fittig and Stelling, and then describes a series of identical compounds as those obtained by the parties just named, but prepared in a different manner. Chiefly the effect of a different temperature appears to be in play, in this instance, to produce compounds of different physical properties.

On some Products of Decomposition of Tribenzylamine.—M. W. Rohde.—This paper, being a critical review of M. Limpricht's labours on this subject, is not well suited for abstraction.

Determination of the Equivalent of Albumen.—M. Fuchs.—After briefly reviewing the researches made by Messrs. Schwarzenbach, Lieberkuhn, and others, on this subject, the author describes a series of his own experiments, the main result of which is that the precipitates formed by albuminous substances and platino-cyanide of potassium are substances of variable composition and decomposable by water. The author also found that the silver compound of albumen applied by M. Lieberkuhn for the determination of the albumen does not answer that purpose, since, on repeating, even up to seven times, the last-named author's experiments, he found the results to vary considerably, and, among themselves, to be different from those obtained by M. Lieberkuhn. On repeating M. Commaille's experiments on this subject, the author found that his very carefully-conducted experiments agreed with those of the last named gentleman very closely, and that, therefore, the compound obtained when chloride of platinum and a slightly acidified solution of albumen are mixed is the precipitate best suited for the determination of the equivalent of albumen.

Occurrence of Laurite in the Platinum Ore found in the Oregon Territory, U.S.—Professor Wöhler.—Laurite is a mineral, first met with in the platinum ores found in Borneo, and composed of sulphide of ruthenium and sulphide of osmium. In the platinum ore here alluded to, this mineral is met with in such minute crystals that they are only distinguishable when magnified 50 diameters. Chemical tests, however, distinctly detected the laurite, which has been fully described some years ago by this eminent author.

Zeitschrift für Chemie von Beilstein, No. 15, 1869.

This number contains the following original papers:—

On Orthonitrodichlorophenol and an Isomeric Dichlorophenol.—M. O. Seifart.—Orthonitrodichlorophenol, $C_6H_2Cl_2NO_2OH$, is a solid substance, crystallising, from its ethereal solution, in rhombic-shaped crystals; soluble in ether, alcohol, and chloroform, but not in water; is not capable of being sublimed; fuses at 125°, but becomes decomposed at the same time. The author gives a catalogue of salts which this substance forms:—The ammonium salt, $C_6H_2Cl_2NO_2ONH_4 + HO$, is a crystalline substance, readily soluble in hot water; orthoamidodichlorophenol is a solid substance, soluble in water, but far more readily in alcohol, and fuses at 166°; dichlorphenol, $C_6H_3Cl_2OH$, is a solid substance, difficultly soluble in water, readily soluble in alcohol and ether, fuses at 65°, and boils at 220°.

On Chloronitrophenols.—MM. Faust and Saame.—Chloronitrophenol, $C_6H_4Cl(NO_2)O$, is a solid body, exhibiting bright yellow-coloured, large-sized crystals; it smells like saffron, fuses at 87°, is nearly insoluble in water, but readily soluble in alcohol and ether; it forms salts which crystallise, and are readily soluble in warm water. The authors give a lengthy catalogue (the name and formulæ) of a series of these salts, and distinguish α, β, and otherwise designated compounds, which, however, vary only in slight particulars from each other.

Decomposition of Acetate of Silver by Iodine at a High Temperature.—M. Birnbaum.—When a mixture of acetate of silver and iodine is submitted to heat, there ensues, at a comparatively low temperature, a very strong reaction, the products of which, partly vapours, and partly permanent gases, were, by suitable means, condensed and collected by the author. Among the condensable vapours, he found acetate of methylic ethyl, boiling at 55°, and hydrate of acetic acid. Among the gases, carbonic acid, acetylen, and, beside this, another carburetted hydrogen were found. The solid residue of the reaction consisted of iodide of silver and some carbonaceous matter. The author enters into a very lengthy discussion as to the origin of the different substances found, but we cannot follow him therein, since it would require the reproduction of an enormous series of formulæ. When acetate of silver is heated by itself, a very violent reaction ensues, which sometimes even comes to actual combustion. The reaction yields acetic acid, and, among the gaseous products, CO_2 and marsh gas. The residue in the retort was found to consist of metallic silver and carbon.

Definition of the Place to be Assigned to the Benzol Series.—M. V. von Richter.—A paper not suited for abstraction.

New Method of Formation of Ortho-Chlorobenzoic Acid.—M. Wroblevsky.—When sulpho-diazo-

chlorotoluol is boiled with anhydrous alcohol, there is formed ortho-chlorotoluol, $O.C_6H_4Cl.CH_3$, a fluid boiling at 156°, and which, on being treated with chromic acid, yields ortho-chlorobenzoic acid, a solid substance, difficultly soluble in water, but readily so in alcohol, and fusing at 151°.

Behaviour of Toluidine towards Bromine.—W. Wroblevsky.—When, into an alcoholic solution of toluidine, a mixture of air and vapours of bromine are passed, a large quantity of dibromotoluidine, and only very little monobromotoluidine, is formed; the former precipitates, and is collected on a filter. After addition of water to the alcoholic solution, the filtrate is evaporated, and until after having ceased to give off acid vapours. Ammonia is then added, in order to precipitate monobromotoluidine. Dibromotoluidine—

$$C_6H_2Br_2(NH_2).CH_3,$$

is a solid body, crystalline, fusing at 73°, soluble in alcohol and ether, not in water.

On Ethyl-Phenol.—MM. Beilstein and Kuhlberg.—The authors state, first, that it is just possible that tyrosin may be equal to amido-ethyl-para-oxybenzoic acid, $C_9H_{11}NO_3$, and they tried to obtain it (tyrosin) from ethyl-para-oxybenzoic acid, which latter acid may be made by acting upon ethyl-phenol with sodium and carbonic acid. The researches made by the authors, and described in this paper, are, as might be expected, of a very complex nature, their aim being the synthesis of tyrosin. We regret that the paper is not suited for further abstraction.

Moniteur Scientifique, No. 305, September 1, 1869.

This number contains, as usual, a series of very well written papers, but those which are original do not belong to the domain of chemistry. Among the *brévets d'invention*, we briefly notice that MM. Broenner and Gutzkow have obtained, in France, a patent for the manufacture of anthracen, by distilling the asphalte, employed for making street pavements, with super-heated steam, and a subsequent sublimation of the raw product obtained. The anthracen is converted into anthraquinon, by gently heating the former with twice its weight of nitric acid, sp. gr. 1·3 to 1·5, and washing with water the product obtained. The anthraquinon is converted into alizarine and purpurine (both are formed at the same time), by dissolving it in gently heated sulphuric acid, to which solution nitrate of protoxide of mercury is added. The material resulting from this reaction is dissolved in an alkali, filtered, and next precipitated by an acid, whereby variable quantities of alizarine and purpurine are obtained. This process of manufacture is already carried out, on the large scale, by MM. Meister, Lucius, and Co., at Hoechst, near Frankfort-on-the-Maine, and is a great improvement upon MM. Græbe and Liebermann's method. The editor of the French paper above named states that he received from the manufacturers just named a sample of a ¼ of a kilo. of this artificially-prepared alizarine.

No. 306, September, 15, 1869.

This number contains only the following original communication:—

A Letter from MM. Meister, Lucius and Co., at Hoechst, near Frankfort-on-the-Maine (dated September 10th last), wherein these parties state that they are not manufacturing artificial alizarine by the method for which MM. Broenner and Gutzkow have taken a French patent. They also desire it to be understood that, for some time already, they have manufactured a substance which they call *alizapurine*, by a process kept secret. M. Camille-Kœchlin, of Mulhouse, after having very carefully tested a sample of the substance made by the manufacturers above-named, states:—"The sample sent, though it is not truly an alizarine in the strictest sense, since it differs, in many respects, from genuine alizarine, as obtained from madder, or as that lately produced by artificial means, yields, however, in its application, colours superior to those obtained from madder and any of its commercially made products; and no doubt the material made by MM. Meister and Lucius will be the madder of the future." M. Kœchlin adds—"The paste, for in that state it is obtained, I experimented with has fully five times the tinctorial power of madder, and all the colours are more brilliant.

The other papers contained in this number are not original, and, excepting the *brévets d'inventions*, are already either published by us in full—as, for instance, Mr. Abel's paper on explosive substances—or have been abstracted by us from the original publications in which they appeared.

Revue Hebdomadaire de Chimie, September 9, 1869.

Apparatus for the Liquefaction of Protoxide of Nitrogen and other Gases.—M. Deleuil.—The apparatus, of which an excellent woodcut is given, is an improvement upon the very generally used and well-known apparatus of M. Natterer, of Vienna, and, in principle, the same—viz., a force-pump, to the piston of which an upwards and downwards movement is imparted by means of cranks and wheelwork. The recipient for the condensed gas, and the body of the pump, are surrounded by a strong freezing mixture, and the recipient is provided with properly constructed valves, whereby it is possible to make, with ease and comfort, and without danger, experiments with liquefied gases in a lecture-room; while the apparatus for condensing the gases is placed in a separate room by itself. Without reproducing the cut, we cannot enter into more details on this subject. The price of the apparatus complete is, at Paris, 1900 francs (£76).

Annales de Chimie et de Physique, August, 1869.

This number contains only one original paper, or, rather, a lengthy essay, on—

Interrupted Currents.—M. A. Cazin.—This essay is strictly of a mathematico-physical nature, and not suited for abstraction.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 140, August 15, 1869.

This number does not contain any original paper relating to chemistry or allied sciences.

Comptes Rendus des Séances de l'Académie des Sciences, October 4, 1869.

A great portion of this number is devoted to lengthy discussions upon the manner in which the metrical system has been obtained. Those who have a desire to impugn its accuracy have brought forward several alleged facts relating to inaccuracies committed during the geodesical surveys which preceded the introduction of the *metre*. It is satisfactory, however, to find that these inaccuracies are only imaginary, and the discussions here alluded to fully bring out the important fact, that those who desired to detract from the value of the work of the committee of 1790 are mistaken, even so much so as to confuse works of far later date (1808) with those done in 1789 and 1790.

Artificially-Crystallised Silver Amalgam.—M. E. Dumas.—It appears that at the Mint at Bordeaux (France now keeps up three mint establishments—one at Paris and one at Strasbourg), there has been left standing, in an iron mercury bottle, a quantity of about 10 kilos. of that metal, which had been used to extract the silver out of some refuse residues. On filtering through chamois leather, there were left upon the filter a certain number of well-defined crystals, which, on analysis, were found to contain, in 100 parts:—Silver, 27·4; quicksilver, 72·6; and traces of gold. The native amalgam of these two metals contains in 100 parts, silver, 36, and quicksilver, 64, corresponding with the

formula $AgHg_2$. The crystals above alluded to correspond to the formula $AgHg_3$.

Disappearance of the Acids of the Grape and their Probable Conversion into Sugar.—M. Petit.—The author states that the ripening of grapes is accompanied by the disappearance of a large quantity of acid. Green, unripe grapes yield, on an average, 36 grms. of acid to the litre. When the grapes ripen, they double in bulk, and ought, if only water had been added during the process of ripening, to have yielded 18 grms. of acid to the litre, while only from 5 to 6 grms. is detected by analysis. It should be stated that this result is not due to the saturation of the acid by bases, since the ripe grape contains less base than the unripe grape does.

Constitution of Pseudotoluidine.—M. Rosenstiehl.—The author gives the following *résumé* of his paper on this subject:—"I wish to acknowledge an error formerly made, to point out that the constitution of pseudotoluidine is not yet accurately known and well established." Lastly, the author states that he does not intend to pursue studies on this subject any further. The paper is chiefly a critical review of the labours of others on this subject as compared with those of the author.

Cosmos, October 2, 1869

Manufacturing Manure from Offal of Wool.—M. Pichelin.—Fifty kilos. of this offal are mixed with 33 kilos. of concentrated sulphuric acid and 35 kilos. of nitric acid, sp. gr., 1·321. This mixture is well stirred up for about ten minutes, and next mixed with some native phosphate, coprolites, for instance, in the proportion of 100 kilos. of the acid mixture to 200 kilos. of very finely ground up phosphates. This manure becomes, in forty-eight hours, as hard and dry as rock, so that it has to be ground up again under mill-stones.

Conservation of Wood by Solutions of Salts of Copper.—M. Morin states that he has in his possession wooden water-wheels which have been in use for more than 1500 years for the evacuation of water from a copper mine. These wheels have a diameter of 6 metres; and, on a portion of the wood being analysed by M. Payen, it was found to be perfectly sound, and to be partly converted into a compound of cellulose and copper, precisely similar to that which is formed in Boucherie's process for the preservation of wood by sulphate of copper.

Tanned Cotton, also called cotton-leather, is prepared by treating cotton fabrics in a similar manner to that in which skins and hides are treated for the manufacture of leather. Cotton hereby acquires greater strength, and is more enabled to resist the effects of moisture and disintegrating efforts.

Zeitschrift für Chemie von Beilstein, No. 16, 1869.

We find in this number the following original papers:—

Test for Arsenic and the Preparation of Hydrochloric Acid free from Arsenic.—M. Bettendorff.—When arsenious or arsenic acid is dissolved in fuming hydrochloric acid, and there is added thereto a solution of protochloride of tin dissolved in hydrochloric acid, a brown-coloured very bulky precipitate, which rapidly settles down, is formed, which precipitate, after having been collected on a filter and washed, first with hydrochloric acid, next with water, to remove the latter entirely, constitutes, after having been dried over sulphuric acid *in vacuo*, a greyish coloured powder, of metallic aspect; this, on being rubbed in an agate mortar, exhibits metallic lustre, and is volatile on being heated, while oxide of tin, in the shape of a very light powder, is left. On being analysed, the precipitate was found to consist of from 98·46 to 95·86 per cent of metallic arsenic, according as to its preparation, arsenious acid, arsenic acid, or arseniate of ammonia and magnesia had been applied. The precipitate could never be obtained quite free from tin. The author further states that when the hydrochloric acid employed has a sp. gr. of 1·115, the arsenious or arsenic acids dissolved therein become, if not entirely, at least for the major part, converted into chloride of arsenic; and the reaction described, therefore, takes place between that chloride and protochloride of tin. When the hydrochloric acid has a sp. gr. of 1·100, the arsenious acid is not converted into chloride of arsenic, but is dissolved as arsenious acid; chloride of tin does not act upon combinations of antimony under the same conditions. The author advises that crude hydrochloric acid, sp. gr. 1·164, should, in order to eliminate all arsenic from it, be treated with a strong solution of protochloride of tin in pure HCl, left standing for twenty-four hours, the precipitate removed by filtration, and the acid next placed in a retort, the first 1-10th of the distillate kept separately, and the remainder distilled off to dryness, when that portion will be found absolutely free from arsenic; the first 1-10th might, in some cases, retain 0·02 per cent of that metal.

Orthoxylol, a New Modification of Dimethyl-Benzol.—MM. Bieber and Fittig.—The authors have discovered a new hydrocarbon, C_8H_{10}, which differs from isoxylol and methyl toluol, and has been named by them *orthoxylol*. It is a fluid body, and boils at 141°; it is distinguished from other substances of isomeric composition by the difficulty wherewith it yields nitro-combinations, and, also, by the slow action which a mixture of chromate of potassa and sulphuric acid exerts upon this substance.

On Bromotoluol, Bromotoluol-Sulpho Acid, and Isomeric Sulpho-Hydrate of Toluol.—MM. Hübner and Wallach.—This rather lengthy paper is not at all suited for any useful abstraction with due justice to the labour of the authors.

Action of Sulphurous Acid upon Chloride of Platinum.—M. Birnbaum.—The author reviews, at some length, the labours of other investigators on this subject, and then states that, when ammonio-chloride of platinum is placed in a concentrated aqueous solution of sulphurous acid, and the mixture heated on a water-bath, care being taken to keep excess of sulphurous acid, a yellow solution is obtained; this solution was evaporated to dryness, again some aqueous SO_2 added to it, and dried over SO_3. A compound was obtained in crystalline state, which contained platinum, ammonium, chlorine, and sulphurous acid—Pt: 3Cl: SO_2: $2NH_4$. When the strongly acid solution of ammonio-chloride of platinum in sulphurous acid was saturated with carbonate of potassa, a salt was obtained wherein the different component bodies were contained in the proportion expressed by Pt: 3Cl: SO_2: $2NH_4$: K. This salt is the potassa salt of the acid first obtained by the action of SO_2 upon ammonio-chloride of platinum in combination at the same time with chloride of ammonium. The formula of the acid just alluded to is—

$$Pt\left\{\begin{matrix}Cl\\HSO_2\end{matrix}\right\}+2NH_4Cl.$$

The author succeeded, by means of a complicated set of experiments, in substituting, for both atoms of chlorine of the chloride of platinum, the radical HSO_2, and thus obtained a crystalline compound—

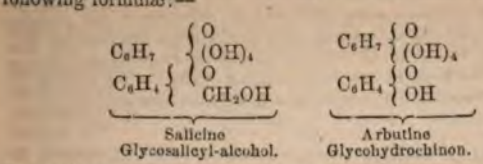
$$Pt\left\{\begin{matrix}HSO_2\\HSO_2\end{matrix}\right\}+2NH_4Cl+H_2O.$$

No. 17, 1869.

This number contains the following original papers:—

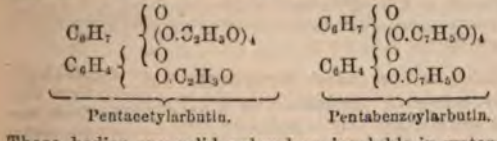
Contribution to our Knowledge of Isomerism in the Benzoic Acid Series.—M. Hübner.—This memoir is a critical review of the labours of M. V. von Richter on the subject above-named; and the author defends his own experiments on this subject, and proves that M. V. von Richter has made several mistakes. The paper is not suited for abstraction.

On Arbutine.—M. A. Schiff.—Just in the same manner as salicine can be split up into glycose and saligenin, arbutine is split up into glucose and hydrochinon. The relation between salicine and arbutine may be represented by the following formulæ:—



Salicine Glycosalicyl-alcohol. Arbutine Glycohydrochinon.

Benzoyl-arbutine is prepared by means of chloride of benzoyl; the acetyl-arbutine is prepared by the action either of acetyl-chloride or of acetic anhydride. The final products of these reactions contain five acid radicals, and are made up according to the following formulæ:—



Pentacetylarbutin. Pentabenzoylarbutin.

These bodies are solid, colourless, insoluble in water, very slightly soluble in ether, and better soluble in hot alcohol; the acid radicals can be removed by boiling with weak bases. The author's paper is full of a series of formulæ similar to those here quoted; he states that an aqueous solution of arbutine reduces freshly precipitated oxide of silver readily at a low temperature, A solution of arbutine yields, with solution of perchloride of iron, a deep blue colouration, which gradually disappears; but the derivatives obtained from arbutine do not do so.

Isomeric Nitrotoluols and Toluidines.—MM. Beilstein and Kuhlberg.—After referring to the experiments made on the subject by M. Rosenstiehl, the authors state that the party just named did not enter into any particulars as regards the splitting up of nitrotoluol into its different components—that is to say, all of them nitrotoluols differing from each other by slightly modified properties, the various bodies being distinguished by the prefixes *a*, *β*, and so on. The paper is rather a catalogue of formulæ, and is divided into five sections, treating of the sulpho-acids; toluidines and para-toluidines; aceto-toluides; toluidine derived from xylol; and *β* chlorotoluol, $C_6H_4Cl.CH_3$. The authors, moreover, state that this paper is intended only as a general survey of the subject, and that they continue their researches thereon.

Isomeric Nitro-Ethyl-Benzol and Xylidine.—MM. Beilstein and Kuhlberg.—*a* nitro-ethyl-benzol boils at 246°, has a specific gravity of 1·124 at 25°, and is a yellow-coloured fluid; *β* nitro-ethyl-benzol is also a liquid, boils at 227°, sp. gr. 1·126 at 24°. The *a* compound is capable of yielding acids; not so the *β* compound. Xylidine, $C_6H_4.C_2H_5.NH_2$, corresponding to the *a* nitro-toluol, boils at 214°, is a limpid liquid, which becomes readily brown-coloured on exposure to air; sp. gr. 0·975. The *β* xylidine boils at 210°. Acetoxylide, $C_6H_3.NH(C_2H_3)O$; the *a* compound boils at 317°, fuses at 94°, and is somewhat soluble in hot water; the *β* compound is readily soluble in hot water, and boils at 305°; both are solid bodies.

On Dichloric and Trichloric Benzoic Acid.—MM. Beilstein and Kuhlberg.

Derivatives of Benzol obtained from Toluol.—MM. Beilstein and Kuhlberg.—These papers are not well suited for abstraction.

On Paratoluidine.—MM. Hübner and Wallach.—Paratoluidine is a liquid which in pure state resists a cold of −21° without becoming solid, is very readily soluble in alcohol and ether, and rather soluble in water; with acids, it yields salts which crystallise. Sulphate of paratoluidine, $(C_6H_4NH_2.CH_3)_2SO_4H_2$, is very readily soluble in water. Acetoparatoluide, $C_6H_4.CH_3.NH.C_2H_3O$, is a solid body exhibiting needle-shaped crystals, fusing at 105°, soluble in alcohol and ether, but not readily soluble in water.

Solubility of Nitrates in Nitric Acid; Separation of the Nitrates of Potassa and Soda from each other.—M. C. Schultz.—Nitric acid does not form acid salts. Several nitrates which are readily soluble in water are difficultly soluble in nitric acid; and this fact explains why silver, lead, and iron are not readily acted upon by very concentrated nitric acid. One part, by weight, of the undermentioned salts require for their solution in—

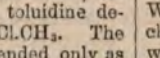
	The First Hydrate of Nitric Acid, HNO_3.		Hydrated Nitric Acid, $2HNO_3+3H_2O$.	
			(At 20°.)	(At 123°.)
	Parts.		Parts.	Parts.
KNO_3	1·4	....	3·8	 1
$NaNo_3$	66·0	....	32·0	 4
$LiNO_3$.....	200·0	....	—	.... —
$AgNO_3$	500·0	....	30·0	 6

The nitrate of baryta, strontia, and lead are as insoluble in both the above-named nitric acids as the sulphates of these metals are in water. The nitrates of potassa, rubidium, and ammonia are readily soluble in hydrated nitric acid. The author is of opinion that by far the greater solubility of nitrate of soda than nitrate of potassa in nitric acid might be applied to the separation of these salts from each other; but the author very properly observes, also, that working with nitric acid, especially on the large scale, is, in many instances, impracticable. For analytical purposes, this plan is not suitable, since chloride of sodium is rather insoluble in nitric acid.

No. 18, 1869.

This number contains the following original communications:—

Researches on the Sulpho-Acids of Benzol.—M. Ross Garrick.—This paper contains an enumeration of the most prominent salts of the three following acids:—From benzolsulpho acid, C_6H_4Br,SO_2HO; isobromobenzolic acid, $C_6H_4BrSO_4HO$; benzoldisulpho acid—



Without reproducing a very lengthy series of formulæ, the chief contents of this paper, we do not find therein anything worth much notice, and therefore abstain from further quotation of its contents.

New Method of Converting Fatty Acids into their Alcohols.—Dr. Saytzeff.—This is simply a preliminary notice, *pour prendre date*, written from Kasan. The author says that, when sodium amalgam is suffered to act upon a mixture of fatty acids and their anhydrous chlorides, the alcohols belonging thereunto are obtained; for instance, acetic acid and acetyl-chloride yield ethylic alcohol. The author promises full and complete details in a future paper.

Formation of Aniline from Bromide of Benzol.—MM. Hübner and Alsberg.—This paper is also marked "preliminary notice." It is written with the object of elucidating the question, Whether the atoms of hydrogen contained in benzol do all occupy the same rank? In order to settle this point, the authors have set to work to obtain, from different bromated and chlorinated benzols, anilines, and to compare these mutually. For this purpose, bromide of benzol was nitrified, with the result that two varieties of bromonitrobenzol were obtained; one of these compounds, evidently, is the same as that described by M. Couper; the other compound is a monobromonitrobenzol, fusing at about 38°, and yielding, on being amidised, two bromoamido compounds. The bromonitrobenzol (Couper's) fuses at 125°, and yields, on being treated with tin and hydrochloric acid, an amido compound, $C_6H_4BrNH_2$; this, on being first treated, while in alcoholic solution, with sodium, and next with chloracetyl,

[English Edition, Vol. XX., No. 516, pages 189, 190.]

yielded an acetanilide, fusing at about 116°, soluble in water, and more readily soluble in alcohol and ether. The authors promise full details on this subject afterwards.

Thihydrobenzoic Acid.—MM. Hübner and Upman.—A short "preliminary notice." When sulphobenzoic chloride is brought into an apparatus wherein hydrogen gas is briskly evolved from tin and HCl, a white substance is separated, which, on being collected on a filter, washed with water, dissolved in ammonia and re-precipitated by HCl, and boiled in alcohol to which HCl is added, there is obtained a solid crystalline substance, a compound which, on being submitted to elementary analysis, was proved to consist of $C_6H_4.SH.COOH$; this body the authors have named thihydrobenzoic acid; it fuses at 242°, is difficultly soluble in alcohol, and insoluble in water.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt. First two numbers for 1869.

Of this periodical, published by the Austrian government, one number is published at the end of each quarter of the year. Very frequently these papers contain the results of chemical researches and analyses, and these we briefly abstract:—

Phosphatic Nodules from the Chalk Formation of Russian Podolia.—Dr. Alth.—Leaving the purely geological portion of this paper, and the discussion on the origin of the phosphate nodules in general, and especially of the variety here alluded to, the author states that the result of the analysis for this mineral is, for 100 parts:—Water, 0·65; silica, 14·18; lime, 26·12; fluorine, 11·69; alumina, 0·99; phosphoric acid, 23·50; iron (*eisen*), put down as metal, 9·23; cobalt, 4·60; manganese, 1·40; sulphuric acid, 2·10; magnesia, 3·52; potassa, 1·20; loss, 0·82.

Analyses of Several Kinds of Common Salt from Galicia.—M. A. von Kripps.—This paper is subdivided into several sections. The average composition of rock-salt from Stebnik is, in 100 parts:—Chloride of sodium, 90·281; chloride of potassium, a trace; chloride of magnesium, 0·286; chloride of calcium, 0·508; sulphate of lime, 8·245; water, driven off at 160°, 0·680. Rock-salt from Kossow contains, in 100 parts:—Chloride of sodium, 98·0; alumina, 1·7; loss by heat (water driven off at 160°), 0·2. We have only selected a couple of samples from among a number of about one hundred. It appears that Galicia is very well provided with deposits of rock-salt, which is wrought out by mining processes, and that, by boring, saline springs of sufficient strength to admit of boiling down and obtaining salt thereby, are found in large numbers.

Researches on the Mineral Water of Rajec-Toplitz.—M. E. Glasel.—In a remote portion of the Comitate of Trentschin, near Sillein, a mineral spring is met with, the water of which is the subject of this memoir. The temperature of this water varies from 26·5° R. to 20·4° R. The water is colourless, devoid of smell, has a saline astringent taste, and exhibits, in its natural state, alkaline reaction. In 100 parts, the composition of the dry saline residue is quoted as follows:—Calcium, 52·63; magnesium, 33·29; sodium, 9·21; potassium, 2·83; aluminium, 2·02; oxide of iron, a mere trace; carbonic acid, 82·17; sulphuric acid, 16·57; chlorine, 1·31; silica, 0·80; phosphoric acid and iodine, a trace; free carbonic acid, 7·05; sp. gr., 1·000768.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 7, 1869.

This number contains only one paper relating to chemistry:—

Presence of Chloride of Sodium in the Water and Rocks of the Coal Formation of Luijk (Liege). M. R. Malherbes.—The paper here quoted is not the original work of the author, but two reports on his paper, one of which is written by the well-known M. Omalius D'Halloy, the other by M. Dewalgue. Both these gentlemen differ from the author above-named, as regards his opinion that the formation of coal should have taken place in salt-water ponds; but they also state that it is difficult to explain why some samples of sandstone of the locality above-named should contain 0·101 per cent of chlorine, while in other samples of the same stone, and in the same locality, no chlorine is found at all. Some of the schistose rocks contain 0·085 per cent of chlorine; others, again, none of this element, notwithstanding they are found close by each other and evidently belong to the same geological formation.

Journal de Pharmacie et de Chimie, September, 1869.

This number contains the following original articles:—

Laws which Regulate the Part any Substance Plays between Two Solvents.—MM. Berthelot and Jungfleisch.—A paper on this subject, recording researches of the same nature, was published by these authors, and noted by us from the *Comptes Rendus*, therefore we do not further allude to it here.

Purifying of Bromide of Potassium.—MM. Bobierre and Herbelin.—The authors state that when bromide of potassium is adulterated, or mixed with iodide of potassium, it is, in order to detect this, only necessary to place a few grains of the salt in question on paper previously impregnated with starch paste, to moisten it, and admit a small quantity of chlorine gas, whereby the iodine is set free and the paper coloured blue. A better test, given by the authors, is the use of bromine, added to the salt after it has been placed under benzol; if the latter becomes red-coloured, iodine is present. The title given to this paper should have been "On the Detection of Iodine in Bromide of Sodium."

Preservation of Eggs.—M. Violette.—The main results of this paper are the already long known facts that eggs may be kept in perfectly fresh state by varnishing them over with a so-called drying oil, linseed oil being preferred on account of its cheapness; poppyseed oil also answers this purpose perfectly well.

Bayerisches Industrie und Gewerbeblatt, July and August, 1869.

These two numbers, published together, contain, among the officially-published material, most excellently drawn-up and well-digested law, and police regulations, for the management and traffic of the railways of the Kingdom of Bavaria. The duties, as well as the rights, of the officials thereby employed, as well as of the travelling public, are clearly and distinctly defined, and every care and precaution is taken to insure the safety and comfort of all concerned. Even in a technical point of view, this document deserves the notice of all who have anything to do with, or authority over, railways, which, as evidenced also in Bavaria, are better managed, and with more profit to the nation at large, by the State than by private companies.

Ceramic Industry of Kronnigen, Lower Bavaria.—Dr. Wimmer.—The Kingdom of Bavaria is rich in various qualities of clay fit for the most varied kinds of pottery, from the finest china, made near Nymphenburg, to the coarse but highly refractory clay which is made up in so-called Passau melting pots. The clay referred to in this paper, after having been dried at 100° (whereby it lost 21 per cent of water), gave, on being analysed, the following results for 100 parts:—Water, and trace of organic matter (lost by ignition), 2·02; alumina, 27·42; oxide of iron, and traces of oxide of manganese, 6·88; lime, 5·60; magnesia, 0·20; potassia, 0·18; silica, in combination, 19·20; sand and free silica, 38·40. No traces, even of sulphuric and phosphoric acids, chlorine, and carbonic acid could be detected. This clay is fit only for very coarse pottery.

ar.

Schools for Brewing in Bavaria.—Dr. Zängerle.—It appears from this paper that there exist, at Munich and Augsberg, excellently arranged schools wherein everything which relates to the brewing of beer is taught practically and theoretically; and, from the enumeration of the students who attend, they being natives from various European countries, as well as from America, this instruction seems to be highly valued.

Polytechnisches Journal von Dingler, first number for August, 1869.

This number contains the following original papers relating to chemistry:—

Manner in which the Nitrogenous Substances are Divided in the Potatoes.—M. Dietzel.—This lengthy paper contains researches made by the author with a view to determine what portion of the tuber of the potato is richest in protein compounds; and since, according to this author, there exists a peculiar relation between the quantity of the fatty matter contained in this, as well as in other vegetables, he concludes that, where the largest quantity of fat is there also is relatively the largest quantity of protein. The results are quoted as follows:—The layer nearest the skin contains—Proteinoid, 14·16; fat, 0·66; quantity of proteinoid for one part by weight of fat, 21·45. Interior of tuber contains—Proteinoid, 9·50; fat, 0·38; quantity of proteinoid for one part, by weight, 25·00.

Use of a Vacuum in Brewing.—M Jicinsky.—This paper is so entirely of a practical nature that it is not exactly suited for our pages; but the author certainly proves the great benefits brewers would gain by adopting the use of vacuum apparatus.

Second number for August, 1869.

Among the original papers relating to chemistry, we find in this number:—

Peculiar Steam-Boiler Incrustation.—M. Reichardt.—On visiting a manufactory situated on the higher portion of the Thuringian river Saale, the author noticed a boiler incrustation, which, from its very dark brown colour, appeared almost to consist of an oxide of iron containing manganese. The analysis gave the following results:—Water driven off at 100°, 2·10 per cent; insoluble in hydrochloric acid, 17·12; soluble therein, 80.78 per cent. Full analysis, in 100 parts:—Water, at 100°, 2·10; white clay and sand, 8·87; oil and pitch, 8·25; sulphate of lime, 1·80; peroxide of iron, 1·20; protoxide of iron, 0·22; carbonate of lime, 68·52; carbonate of magnesia, 9·60. The dark colour is due, not to the oxide of iron, but to the organic matter, oil, and fat, partly decomposed by the high temperature, and converted into a kind of pitch.

Chemical Investigation of Tablettes de Bouillon Russes.—M. Reichardt.—The substance here alluded to is not in commerce in the western parts of Europe, and is manufactured from the meat, not only of cattle, but also that obtained from game, which latter is very plentiful in the less inhabited portions of Poland and Russia. The researches of the author, who obtained the genuine material from a friend of his who resides in Russia, yielded the following results for 100 parts:—Water, at 180° (without any decomposition), 21·7; fatty matter, 0·22; nitrogen, 10·57; ash, 4·75; soluble in alcohol, 38·09 per cent. The author, having purposely compared these meat lozenges (for so they may be called) with Liebig's extract of meat, comes to the conclusion that the extract is superior in every respect, but that this is counterbalanced by the relative cheapness of the lozenges, and their very convenient portability and non-liability to decay.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, July, 1869.

This number contains the following original communications and papers:—

Researches on those Resins Derived from the Convolvulaceæ, which Act as Drastic Purgatives.—MM. Köhler and Zwicke.—This paper contains an historical review of the discovery and older analysis of *Scammonium jalappa*, and other substances less generally known and now obsolete in Europe, formerly used as physic, and produced by plants belonging to the natural order above named. The chemical researches of the authors are confined to convolvuline and jalapine; the former expressed by the formula $C_{62}H_{50}O_{32}$, the latter by $C_{68}H_{56}O_{32}$. These two substances behave with reagents in the following manner:—

Convolvuline is not soluble in ether, and is precipitated by it from its alcoholic solution; is entirely insoluble in benzol; when evaporated to dryness along with nitric acid, convolvuline becomes violet red-coloured upon the addition of SO_3. The acid solution of convolvuline is precipitated by alum solution. The alcoholic solution of convolvuline is not precipitated by a solution of nitrate of protoxide of mercury. Nitrate of silver produces, in solutions of convolvuline, a pulverulent, non-adhesive precipitate, immediately becoming black-coloured.

Jalapine is perfectly soluble in alcohol and ether; is soluble in benzol, but rather difficultly: but is readily taken up by benzol from its alkaline solutions when these are shaken up with benzol. Jalapine, treated as described, is not coloured at all. Acid solution of jalapine remains quite clear and undisturbed on being treated by alum solution; alcoholic solution of jalapine is precipitated by nitrate of protoxide of mercury, yielding a bulky, caseous precipitate, insoluble, also, on heat being applied. Nitrate of silver produces a bulky, caseous, whitish grey, clotted precipitate in solutions of jalapine, and this precipitate is only slowly changed by the action of the light.

These reactions may serve to distinguish between genuine resin of jalap, and between scammony and its resin.

Description of a Practical Chlorine-Water Apparatus.—Dr. Duflos.—There is added to this paper a woodcut, and, without reproducing it, it is not an easy matter to make this apparatus understood. The chief point is that the pressure of the gas escaping from a mixture of 2 ounces of dry bichromate of potassa, and 11 ounces of commercial hydrochloric acid, is made to saturate, with chlorine gas, 8 lbs. of water, by making the gas to force, by pressure, this quantity of water from one Woulf's bottle into another.

Detection of Wheaten Starch among Arrow-root, and of Wheaten Flour among Starch.—Prof. Boettger.—Take 1 grm. of the material to be tested, put it in a porcelain dish, and add 180 c.c. of distilled water; apply heat, and boil the mixture briskly while stirring continuously and briskly with a glass rod. Any starch which is quite free from gluten—for instance, pure potato starch, or pure arrow-root—will not exhibit, when treated in this way, any foam on the surface of the liquid as soon as the stirring is discontinued; but when the starch happens to contain the slightest trace of gluten, in other words, flour, there will appear on the boiling liquid, during the stirring up, a strong foam, which is so strong that it often resembles the foam on soap-sups.

August, 1869.

This number contains the following original papers:—

Gelatinæ Medicatæ in Lamellis.—Dr. Huseman.—This paper treats on the preparation of a peculiar kind of lozenges, pills, and gelatinous capsules fit to serve as vehicles for either very strong pharmaceutical preparations, which can only be given in very minutely small doses, such as atropine, strychnine, and the like, or substances which are very disagreeable to the taste, as *balsamus copaivæ*, cod-liver oil, &c. The paper is strictly a pharmaceutico-technical one, and we therefore allude no further to it.

Preparation of Pure Hydrochloric Acid.—Dr. Riecker.—The author mixes crude hydrochloric acid, sp. gr. 1·170, (containing 34·25 per cent real HCl), and sulphuric acid, sp. gr. 1·830 (containing 93 per cent. of monohydrated acid), in the proportion of 100 parts, by weight, of the latter

acid and 40 parts of the former (HCl), leaving, after distillation, whereby the HCl is volatilised, a sulphuric acid of 1·650 sp. gr. The loss of HCl in this operation amounts to about 3·5 per cent.

Cultivation of Opium in Germany.—M. Jobst.—This paper is altogether of a botanico-technical nature, treating on the mode and commercial advantages of cultivating the *Papaver somniferum* for the purpose of obtaining opium of good quality, which appears to be perfectly possible in some parts of Southern Germany.

Detection of Alcohol in Chloroform.—M. Blacher.—Add to the suspected chloroform a small piece of caustic potassa, and leave the fluid at rest for a few minutes; then add distilled water, and shake the chloroform therewith. Decant the water, and add a solution of a salt of copper to the aqueous fluid; if a precipitate ensues, the chloroform contains alcohol. Another, and perhaps more reliable, plan to detect alcohol in chloroform is to add to the latter a small piece of quite dry caustic potassa and a piece of reddened litmus-paper; if the latter becomes blue on being shaken up with the chloroform, it is sure to contain alcohol, provided always that it is quite anhydrous.

Revue Hebdomadaire de Chimie, September 16, 1869.

Names Given to Spirituous (Alcoholic) Liquids.—M. Mené.—It frequently happens that some industrial, or commercially-adopted, term, for an alcoholic fluid is not properly understood, and this especially is the case with what, in and out of France, is known as *trois six*, 3-6. All alcoholic liquids are designated according to their strength, as indicated by Cartier's areometer for spirituous liquids. Liquids from 16° to 20° are called *eau de vie*, strictly translated water of life, or life-giving. Holland proof is spirit of 19° Cartier, strong *eau de vie*, brandy marks 21° or 22°. Above that degree, the fluids are named *esprits*, *spiritus*, and, by means of certain cypher figures, written as fractions, the greater or smaller quantity of water which these fluids require, in order to be reduced to the state of ordinary *eau de vie* of 19°, is expressed; for instance, *trois six*, 3-6, is is an alcohol of 33°, three parts of which, by bulk, produce six parts of *eau de vie*. The *trois sept.*, 3·7, is alcohol at 35°, three volumes of which form seven volumes of *eau de vie* at 19°. The word brandy is, no doubt, a contraction for *brantwein*, meaning, literally, burnt wine, since real genuine brandy is obtained by the distillation of certain wines, not as such fit for beverage.

Les Mondes, September 16, 1869.

Another Successful Artesian Well.—The well-known M. Say, the owner of the most extensive sugar refinery in France, situated on the Boulevard de la Gare, at Paris, has just got completed, at his manufacturing premises, the boring of an artesian well. At 562 metres below the surface, a water layer has been reached, yielding 7000 litres of water per minute. The water, which has a temperature of 28° above zero, on reaching the surface, rises to a height of between 20 and 30 metres above the end of the bore-hole at surface level. The cost has been 300,000 francs, and the work has been completed within four years, by the successors to the celebrated MM. Mulot, St. Just-Dru.

Comparative Review of the Composition of Milk from Various Mammiferæ.—In 1000 parts of milk, the undermentioned quantities of the following substances are contained in the milk of the animals respectively quoted:—

	Water.	Butter.	Caseine.	Sugar.	Inorganic matter.
Women	889·08	26·66	39·30	43·68	1·30
Cows	864·20	31·30	48·30	47·70	6·00
She Goats	844·90	56·87	35·14	36·91	6·18
Ewes	832·32	51·31	69·78	39·43	7·16
Mares	904·30	24·36	33·35	32·76	5·23
Asses	890·12	18·53	35·65	50·46	5·24
Sows	818·00	60·00	53·00	60·70	8·30

September 30, 1869.

Strengthening and Rendering Woven Tissues Impermeable to Water.—M. Neumann.—A sulphuric acid bath is made containing acid varying in strength from 40° to 66° Beaumé (specific gravities 1·384 and 1·850), and kept at a temperature of 57°. The woven tissues, cotton or linen, are rapidly passed through this bath, being only left in contact with the acid for from ten seconds to two minutes, according to the nature of the tissue, which is immediately after passed through very cold water, and next submitted to a thorough washing process. The effect of the action of the acid is an incipient dissolution, and formation of a varnish-like matter, which, especially after it has been regularly spread over the fabric, and incorporated therewith by hot-pressing and calendering, greatly increases the strength of the fabric, rendering it simultaneously impervious to water.

Annales de Chimie et de Physique, September, 1869.

This number is entirely filled up with a lengthy monograph, which bears the title—

New Researches on Thermo-Chemistry.—M. Berthelot.—We confine our abstraction to the headings of the different parts and sections of this paper. *Endothermic and exothermic reactions*:—Combinations formed with absorption of heat; on double decompositions; formation and decomposition of formic acid; fermentations and constitution of sugar; on compounds which develope heat when becoming decomposed and in nascent state; formation of protoxide of nitrogen and the decomposition of nitrate of ammonia; chemical action of light; on action by contact; on isomeric transformations; on the influence and effects of pressure upon chemical phenomena; changes of temperature produced by the mixing of divers fluids; general principle involved in all chemical reactions. *On pyrogenetic equilibrium*:—Decomposition of organic substances by heat. This memoir will be continued in another number of this periodical.

Journal für Gasbeleuchtung, August, 1869.

Among the original papers contained in this number we notice:—

What is Cheap Gas?—Dr. Schilling.—The contents of this paper, which is written with an evidently large amount of technical and commercial knowledge on this subject, might be very advantageously translated by our excellent contemporary, the *Journal of Gaslighting*. The idea of cheap gas is, indeed, a very relative one, since it is possible, by those well acquainted with all the *minutiæ* of gas-making, to manufacture gas which, though nominally cheap, may, by want of "durability," and even with a high illuminating power, be very expensive to the consumer.

Photometrical Studies.—M. Elster.—This paper, and the following—

Purification of Coal-Gas.—M. Buhe—are excellent treatises on the subjects, but, unfortunately, too lengthy to admit of any useful abstraction. As regards the purification of gas, it is quite clear, from the manner in which this subject has been taken up abroad, that it deserves deeper looking into than is generally done at gas-works.

Monatsberichte der Koniglich Preussischen Akademie der Wissenschaften zu Berlin, May, 1869.

This number does not contain any papers at all relating to chemistry or sciences allied thereto.

June, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Preparation of Silicic Acid in Crystalline Shape by the Dry Way.—M. Rose.—The paper is identical with that which appeared on this subject, written by the same author, in the *Berichte der Deutschen Chemischen Gesellschaft*, No. 14, 1869, from which it has been abstracted.

Relation of Chloral and Trichloracetic Acid to the Animal Organism.—Dr. Liebreich.—This paper relates a series of physiological experiments aided by chemical reactions. It appears that hydrate of chloral may become a very useful and safe anæsthetic.

Emission and Absorption of Heat Radiated at Lower Temperatures.—M. Magnus.—The author states—"Different bodies heated to 150° emit, by radiation, different kinds of heat; some bodies only emit one kind of heat. Rock salt belongs to those substances which, if it is quite pure, emit different kinds of heat. The author then enters into discussions on diathermancy, and the power of absorption for certain rays of heat; but the paper is too concisely written to admit of any further useful abstraction.

Moniteur Scientifique, October, 1869.

This number opens with a short paper on—

Artificial Alizarine.—M. Kœchlin.—To this paper is added a set of printed calico patterns, dyed in five different species of colours, viz., black, puce, scarlet, pink, and violet, respectively produced by the artificial alizarine of Messrs. Meister and Lucius, as made by them at Hoechst, near Frankfort—madder, garancine, alizarine from madder, and purpurine from madder, both sublimed. From the author's paper, it appears that the substance made by the firm just alluded to is neither artificial alizarine or purpurine, but a new compound, superior to both these substances. Alizarine, indigotine, and luteoline are correlated by the property of being crystallisable by sublimation. Purpurine does not yield solid colours until after it has been sublimed.

Test for Detecting Very Minute Quantities of Iodine.—M. Alfraise.—Take water, 100 grms., stareh, 1 grm., nitrite of potassa, 1 grm.; boil this mixture during five minutes, and, after cooling, pour it in a bottle, wherein it keeps for years without deterioration. When required for use, take 10 c.c., add one single drop of hydrochloric acid. Take as much as a pin's head in size of the dry salt to be tested for iodine, place it in a clean porcelain capsule, and add one drop of the test-fluid last-mentioned. When no iodine is present, no coloration ensues; but the least trace of iodine gives rise to the formation of a well-defined blue colour. The liquid test-fluid, after addition of HCl, keeps quite well in a properly-stoppered small bottle.

Comptes Rendus des Séances de l'Académie des Sciences, October 11, 1869.

The first paper is by M. Duhamel, on the—

Principles of the Science of Forces.—This is the third portion of a work the author is occupied with, the two former parts treating of the science of numbers and the science of space. We mention the title because the writer is an excellent authority on this and kindred subjects.

Expansion of Gases.—M. Victor Regnault.—The author refers, first, to his series of experiments on this subject, made since the year 1842, and states that he believed he had found a method to determine with the same apparatus, first, the specific heat of a gas under constant pressure and variable volume; and, secondly, its specific heat under constant volume, while the pressure varies so as to leave the volume (bulk) constantly the same. Next follows the description of a series of experiments, and conclusions drawn therefrom, made at a later date; while the lengthy memoir is devoted to what the author calls simple expansion, or static expansion—that is to say, the expansion of a gas while at rest, when, by any exterior force, the space it occupies is made larger and the gas comes to rest again after the expansion. The other kind of expansion, called dynamic, is, when a gas, either while at rest or moving, expands while passing through any opening, and escapes into the calorimetric apparatus with all the velocity it has acquired. This memoir is of very great length, and the subject treated with the well-known ability of this eminent author, who, it will be remembered, satisfactorily settled the theory of the pressure of steam under various conditions.

Maximum of Force of Electro-Magnets.—M. du Moncel.—A mathematico-physical treatise.

Electricity Developed by the Dissolving of Salts in Water.—M. Raoult.—The author says the dissolution of a salt in water is a complex phenomenon whereby we distinguish—1st, the *fusion* (melting), or *disintegration* of the salt, whereby heat is absorbed; 2nd, the *diffusion* of saline molecules in water, which also absorbs heat; 3rd, the *combination* of the salt with water, whereby heat is set free. The author then states that the conditions alluded to under Nos. 1 and 2 do not produce any electricity, but that, on the other hand, the combination of a salt with water certainly does give rise to an electric current, to prove which, the author records a series of experimental results.

Condensation (Occlusion) of Nascent Hydrogen.—M. Raoult.—The author states that the small cubes of metallic nickel ordinarily met with in commerce, and which are rather porous, absorb (condense) at least 165 times their bulk of nascent hydrogen under the same conditions as palladium does. The metallic nickel employed was not pure, but was found to consist, in 100 parts, of:—Nickel, 88·4; copper, 8·1; iron 2·7; arsenic, 0·8. Perfectly pure, but yet porous, nickel exhibited the same phenomenon; but not so the compact refined, rolled, or hammered nickel.

Analysis of Raw Yellow Silks of Commerce.—M. Méne.—A series of figures exhibiting the result of the elementary and proximate analysis of a great many varieties of raw silks obtained from divers silk-producing countries of the world. The specific gravity appears to vary between 1·670 and 1·80. The elementary organic analysis is not of much use, since silk in raw state contains:—Substances soluble in water, partly nitrogenous, partly carbohydrates; fatty, resinous, and colouring substances soluble in alcohol and ether; and, lastly, the genuine fibre, a nitrogenous compound again soluble in acetic acid. It is impossible here to quote a lengthy series of figures, which is the less required since it is a well-known fact that raw silk varies considerably, according to to the food, climate, and condition of the worms which secrete this substance.

Researches on Lydine.—M. Guyot.—The author states that when he tried to prepare a certain aniline colour according to the directions given by M. Stark, by treating acid chlorhydrate of aniline with ferricyanide of potassium, and by treating the precipitate with oxalic acid, he did not succeed in obtaining a red colouring matter, as stated by M. Stark. The author obtained, however, a beautiful violet colour, which he calls *lydine*, by the following process:—100 grms. of fuming hydrochloric acid, diluted with 120 c.c.; this mixture is poured into a solution of 90 grms. of the ferricyanide of potassium (so-called red prussiate) and 850 c.c. of water; next boiled for an hour and a half, and cooled. The precipitate which has been formed is washed by decantation, and re-dissolved in a nearly saturated aqueous solution of oxalic acid, whereby the violet colour is immediately developed; and, on evaporating this solution to dryness, a paste soluble in water is obtained, which is the extract of lydine. The acid solution just alluded to may serve for dyeing silk and wool without mordants; cotton mordanted with alumina assumes the dye, also, readily. Pure lydine is a beautifully blue violet-coloured powder, soluble in alcohol, difficultly soluble in ether and benzol, and insoluble in water.

Elimination of Lime from Natural Waters by means of Oxalic Acid.—M. Monier.—Upon 100 litres of water from the Seine, 20 grms. of oxalic acid are used, previously dissolved in distilled water; an abundant precipitate is formed; after the lapse of twenty-four hours, some 85 litres of water are carefully drawn off by means of a syphon; and, on analysis, it was found that fully two-thirds of the mineral matter contained in the water had been precipitated

and the water rendered very soft. It is clear, however, that the use of oxalic acid could not be made applicable on the large scale, for various reasons, even if the acid itself was less expensive.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 14, 1869.

This number contains the following original papers:—

Preparation of Crystallised Silica by the Dry Way.—M. Rose.—After referring to the experiments made on is subject by himself and others, the author states that he resumed his researches on this subject at the Royal Porcelain Manufactory, at Berlin, and was aided in his work by MM. Elsner and Herzog. The mineral, named adular, was fused with three times its bulk of salt of phosphorus. The fused mass was dissolved in dilute HCl; and perfectly well-defined crystals, though of very small size, were obtained; the specific gravity of these crystals varied from 2·311 to 2·317 for a series of experiments made with the same substances. The silicic acid thus obtained has the properties of tridymite. Another series of similar experiments, made with very pure amorphous silica, yielded, again, microscopically-small crystals; but their shape did not differ from those obtained with adular. A large number of similar experiments were made with different fluxes, leading to the result that the preparation of crystallised silica by the dry way, or fusion process, has as yet only succeeded in the production of crystals shaped like tridymite and opal. The author is engaged in further investigations on this subject.

Bases of the Picoline Series.—M. A. Baeyer.—Picoline is obtained when tribromallyl is strongly heated with alcoholic solution of ammonia. There is, at first, formed dibromallylamine, and, next, picoline. Aldehydine, a newly-discovered base, prepared also by this author, is homologous with picoline. During the formation of aldehydine, there are formed oxytetraldine, oxypentaldine, and also collidine.

On Cinchonine-Chinoline.—M. Lubavin.—When chinoline is heated for some days, at 100°, with fuming sulphuric acid, the result is the formation of chinosulphuric acid, $NC_9H_6.SO_2OH$. This substance is difficultly soluble in cold water, more readily so in hot water and alcohol, and insoluble in ether. When this acid is heated, along with water and bromine, at 100°, there is formed a bromated chinoline, and, not simultaneously, a bromated sulpho acid. When chinoline is treated with a concentrated solution of caustic alkali, a greenish blue-coloured substance is produced, which is also produced when cinchonine is so treated; on addition of water, this colour disappears, and there is then formed a brown-coloured amorphous substance.

Products of the Distillation of Raw Spirits.—MM. Krämer and Pinner.—The authors had an opportunity of investigating the different products which, by the distillation of spirits—that is to say, the manufacture thereof—from grain, are formed, and can be separately collected, owing to the perfection of the rectifying apparatus in use, on the large scale. Among these substances are prominent—aldehyde, acetal, propyl-alcohol, butyl-alcohol, acetic ether, fusel oil, and a mixture of different substances.

On Monobromobenzolsulpho-Acid.—M. Genz.—The acid just named has been first prepared by M. Couper. The author has obtained it by placing benzol-sulpho acid, bromine, and water in sealed tubes, and heating to 150° in an oil-bath for about five hours. After a lengthy process of purifying, a substance was obtained of which the baryta, copper, and ammonia salts were investigated, and the acid itself set free from the copper salt, by means of sulphuretted hydrogen. The acid so prepared exhibits deliquescent crystals. The baryta salt, $Ba(C_6H_4BrSO_2)_2 + H_2O$, is soluble in hot water and insoluble in alcohol. The copper salt, obtained from the baryta salt by double decomposition with sulphate of copper, crystallises readily, and is soluble in water and alcohol.

Nitro and Amido Derivatives from Cyanide of Naphthyl.—M. A. Welkov.—The author prepared, from a cyanaphthyl, $C_{11}H_7N$, a nitro-compound, which crystallises from its alcoholic solution, and is composed of $C_{11}H_6N_2O_2 = C_{10}H_6(CN)(NO_2)$. From that compound, the amido base was obtained, by means of a reducing agent, the hydrochlorate of which has the formula $C_{11}H_9N_2Cl$.

Some Derivatives from Bromide of Aniline.—M. W. Otto.—Dibromated diphenylsulpho-carbamide, $C_{12}H_{10}Br_2N_2S$, a solid crystalline substance, soluble in alcohol, fusing at 178°, subliming at 200°; insoluble in water, both hot and cold, also insoluble in ether, and readily soluble in hot alcohol. Bibromated diphenylcarbamide, $C_{12}H_{10}Br_2N_2O$, also a solid substance, sublimes at about 222°, without entering into fusion. Quadribromated diphenyl-carbamide, $C_{12}H_8Br_4N_2O$, again a solid crystalline substance, difficultly soluble in any neutral menstruum. Bromated phenyl-senfol (essential oil of mustard), C_7H_4BrNS, a crystalline substance exhibiting the smell of aniseed, fusing at 60°, and soluble in alcohol and ether.

On Isomeric Xylidine.—Drs. A. W. Hofmann and C. A. Martius.—This paper, and the following:—

On Naphthaline Red.—Dr. Hofmann—are not well suited for abstraction with due regard to the contents and the labour of the authors.

Action of Cyanogen upon Anthranilic Acid.—M. Greiss.—The author, after having briefly reviewed his former investigations on the action of cyanogen upon amido-benzoic acid, treats, in this paper, at very great length, on the action of cyanogen upon a compound, $C_{10}H_{10}N_2O_2$, being a product of the action of cyanogen upon an alcoholic solution of anthranilic acid left standing by itself for several days. We regret that it is impossible to enter into further abstraction of this paper, owing to the fact that we should be obliged to reproduce so large a number of formulæ.

Description of an Apparatus for Exhibiting Combustion Experiments in a Lecture-Room.—M. Kekulé.—Without the reproduction of the two woodcuts added to this paper, it is not possible to make the description properly understood.

On Ethyl-Benzoic Acid.—MM. Thorpe and Kekulé.—The authors and M. Fittig having, some years since, synthetically prepared ethyl-benzoic acid from ethyl-benzol, the question treated of in this paper is, to decide whether the ethyl-benzoic acid obtained in this manner is identically the same as that obtained by the last-named party, by means of the oxidation of diethyl-benzol. The result of a carefully-instituted comparative research of the acids obtained in these different ways is that they are quite identical with each other.

On Acetylbenzol.—M. Glaser.—Acetylbenzol, phenyl-acetylen, $C_6H_5.C_2H$. This body has been prepared by the author from phenylpropiolic acid and styrol, and which has been obtained by MM. Berthelot and Friedel by other means, is possessed of the remarkable property of combining with metals and metallic oxides, some of which are treated of in this paper. The copper compound of acetylenbenzol, $(C_6H_5.C_2)_2Cu_2$. Diacetenylphenyl, $C_{16}H_{10}$, is a solid substance, soluble in boiling alcohol and insoluble in water; it is a peculiar hydrocarbon, obtained when acetenylbenzol copper is treated with a concentrated alcoholic solution of ammonia. Acetenylbenzol sodium, $C_8H_5.C_2Na$; this substance has only an ephemeral existence; it is instantaneously decomposed, both by moist and dry air.

Communications from the Chemical Society at Zurich, called the Chemical Harmonica.—M. Meister writes—"At the meeting held on the 27th of July last, MM. Merz and Weith spoke about acetanilide. In pure state, this substance is soluble in hot water, fuses at 113°, crystallises very readily, and is decomposed by sulphuric acid, acetic acid being set free and sulphate of aniline

formed. In order to detect acettoluide among acetanilide, the acetic compound is dissolved in four parts of glacial acetic acid, and next mixed with about eighty parts of water; hereby the acetanilide remains dissolved, while the acettoluide is precipitated. MM. Baltzer and Merz obtained, by distilling a mixture of potassium-disulphonaphthalate and cyanide of potassium, a peculiar cyanide of high melting point, soluble in hot alcohol; this dicyannaphthaline is entirely acidified (*acidificirt*) by treating it with alcoholic solution of potassa, or by HCl at about 199°, while ammonia is at the same time generated.

Derivatives from Uramidobenzoic Acid.—M. Greiss.—Uramidobenzoic acid, $C_8H_8N_2O_3$, is prepared by the action of a mineral acid upon a peculiar basic compound, $C_{20}H_{20}N_4O_5$, obtained by the action of cyanogen and an alcoholic solution of amidobenzoic acid. In this lengthy monograph, the author treats of several derivatives obtained from the uramidobenzoic acid by the action of nitric acid; among these new compounds, dinitro-uramidobenzoic acid, $C_8H_6N_4O_7$, is soluble in alcohol and ether, yielding, on evaporation, well-defined crystals. The paper is too concisely and abstrusely written to be fit for further condensation.

Illustration of the Phenomena of Combustion for Lecture Experiments.—Dr. A. W. Hofmann.—We greatly regret that, in consequence of the absolute necessity of the woodcut added to this paper, for it to be properly understood, we cannot abstract this communication of the eminent author.

Nature of Aniline Green.—MM. Hofmann and Girard. —We have briefly noticed this memoir (see CHEMICAL NEWS, vol. xx., p. 153—*Amer. Repr., Nov.*, 1869, *page* 312). This German paper is identical with the French one already alluded to.

On those Compounds of Essential Oil of Mustard which are Isomeric with Hydrosulphocyanic Acid.—Dr. A. W. Hofmann.—This is the fifth paper on this subject, not well suited for condensation with due regard to the labour bestowed upon the contents by the learned author.

Researches on the Products of Desulphuration of Diphenylsulphocarbamide.—Dr. A. W. Hofmann. —This memoir is too lengthy and too concisely written for any useful abstraction.

On some Superiodides.—M. Jörgensen.—This paper is an abstract of a larger memoir on this subject. The author treats of the superiodides generated when neutral or acid solutions of the hydrochlorates of morphia, codeia, papaverine, narceine, and narcotine are treated with solutions of iodine in iodide of potassium, in which case superiodides are formed which exhibit crystalline structure. Tetraiodide of morphia, $C_{17}H_{19}NO_3HI_4$, is precipitated in crystalline form when, to the aqueous solution of the salt of morphia, an excess of iodide of potassium is added. Teriodide of codeine and teriodide of papaverine, the former, $C_{18}H_{21}NO_3HI_3$, the latter, $C_{20}H_{21}NO_4HI_3$, have been found to contain hydriodic acid, since the alcoholic solutions, when shaken up with metallic mercury, yield double salts, only containing two equivalents of mercury. Sesquiiodide of narceine, $(C_{23}H_{29}NO_9)_2H_2I_3$, is formed when a very dilute solution of the hydrochlorate of the alkaloid is left standing for several weeks, after having been mixed with a dilute solution of superiodide of potassium. The author has extended his researches to piperine, atropine, berberine, theobromine, chinine, cinchonine, methylchinine, methylchinidine, ethylchinine, and ethylcinchonine; also to tetrethylphosphonium; but the great length and the large number of formulæ contained in this paper forbids us entering into more details on this subject.

This number of the periodical contains the queries to which answers are requested:—1st. By the Royal Prussian Academy of Sciences at Berlin; to be replied to before the 1st of March, 1870. The question proposed is the synthesis of either one or more such alkaloids as chinine, cinchonine, morphine, strychnine, brucine, or any non-nitrogenous compounds so related to these bodies, that, by the action of ammonia, it can be converted into the aforesaid bases; prize, 100 ducats, about £50. For 1872, the same premium for a full investigation of the nitrogenous substances contained in wheaten flour and rye flour, and the changes these substances undergo when acted upon by water. 2nd. The Association for the Promotion of the Industry of Prussia asks —The preparation of an enamel on cast-iron, of variegated colours, to be unaffected by exposure to air, and to have proved effectual for at least one year; premium, 300 thalers (£45). For a suitable substitute for the use of arsenic acid in the manufacture of fuchsine (aniline red), provided the substitute be no more expensive and not poisonous or dangerous to deal with; a gold medal, or 1000 thalers (£150). For good replies to the subjoined questions, the same premium:—(1) A method whereby the quantity of aniline and toluidine contained in commercial aniline (*anilinöl*, literally aniline oil) can be accurately, readily, and speedily determined; (2) to determine the influence which the various mixtures of these two substances have in regard to the quantity of aniline obtained; (3) to estimate what weight will yield the largest quantity of crystallised pigment. These three particulars have each to be answered in order to satisfy for the premium. The last meeting of the Chemical Society of Berlin was held on the 11th of October, this being the report of the meeting held on July 26th last.

Bulletin de la Société Chimique de Paris, September and October, 1869.

These two numbers have been published together, and contain the following original matter:—The *proces verbaux* of the meeting of this Society, held on the 2nd and 16th of July last, from which we learn that M. Personne described two new combinations of sulphuric and pyrogallic acids obtained by him. One of these, a conjugated disulphuric acid, exhibits needle-shaped crystals; its baryta salt is efflorescent. This compound is accompanied by a blue substance, a product of oxidation. In addition to these, there is formed a monosulphuric acid, a solid substance, crystallising in large crystals, which, on the addition of baryta, yields a beautiful purplish colour. The author has estimated the sulphuric acid in these compounds by burning them in a current of oxygen gas, and conducting the products of combustion into a solution of permanganate of potassa, and precipitating the sulphuric acid by means of baryta. M. Grimaux spoke on a new kind of nitriles, the oxygenated nitriles of the aromatic series. Salicylo-nitrile, C_7H_5NO, is obtained by the dehydratation of salicylamide by keeping it at a temperature of from 280° to 300°. The new product is a solid body, crystallising in yellow-coloured crystals, fusing at about 285°; almost insoluble in ether, alcohol, chloroform, sulphide of carbon; soluble in 200 parts of boiling oil of turpentine, soluble in aqueous and alcoholic solutions of caustic potassa, and, by fusion with that substance, is transformed into salicylic acid.

The following papers and memoirs were read:—

On a Homologue and Isomer of Choline.—M Wurtz.—This paper is chiefly intended to point out the identity of neurine and choline, which last-named substance was originally found by M. Strecker in bile, while neurine, as discovered by the author of this paper, is artificially produced by the action of triethylamine upon hydrochlorate of glycol.

Action of Hydrochlorate of Glycol upon Toluidine.—M. Wurtz.—The author describes the action of hydrochlorate of glycol upon aniline and toluidine, exposing at great length the different reactions which take place, and the preparation of divers salts, especially with platinum as basis. The memoir is too lengthy to admit of useful abstraction.

Synthesis of Naphthalin-Carboxylic Acid.—M. Eghis.—This acid is obtained by acting with sodium amalgam upon a mixture of monobromated naphthalin and chloroxycarbonic ether. The acid so obtained appears to be identical with the menaphtoxylic acid of M. Hofmann, but differs from the carboxylic acid obtained by means of the cyanide of naphthyl prepared from sulpho-naphthylate of potassium by M. Merz.

Action of Anhydrous Sulphuric Acid upon Perchloride of Carbon.—M. Schutzenberger.—There is produced a liquid boiling at 130°, decomposed by water into sulphuric and hydrochloric acids, fuming in the air, and giving off a smell which is similar to that given off by some of the chlorides of the metalloids. The action of anhydrous sulphuric acid upon tetrachloride of carbon is represented by the following formula:—$S_2O_6 + CCl_4 = CCl_2O + S_2O_5Cl_2$.

Synthesis of Glucosides.—M. Schutzenberger.—The chief result obtained by the author is that the synthesis of genuine glucosides which agree in their properties with those formed naturally is possible by means of the double decomposition of the acetic glucoses (*glucoses acétiques*) and the lead or soda salts of several organic principles. The author is engaged in further researches on this subject.

Acetic Derivatives of the Sugars.—MM. Schutzenberger and Naudin.—This paper is too lengthy and too concisely written to admit of useful abstraction.

Inuline and its Acetic Derivatives.—MM. Ferrouillat and Savigny.—The authors have prepared inuline from dahlia root and from the root of the inula helenium. Notwithstanding that these substances have been carefully manipulated, so as to ensure the purity of the inuline, it appears that, from the experiments made, that this substance, as obtained from either of the two roots named, does not behave in the same manner when treated with acetic acid under exactly similar conditions, but yields products of decomposition which vary greatly. It is impossible to enter into details about these researches, since the paper is too lengthy for that purpose.

Oxidation of Pseudoctylic Alcohol.—M. Clermont.—The products obtained are the same as those yielded by castor-oil when it is oxidised.

Action of Permanganate of Potassa upon Cinchonine and the Existence of a New Alkaloid of the Cinchona Species.—MM. Caventon and Willm.—We have given an abstract of this from another publication.

Salts of Phenetosulphuric Acid.—MM. Opl and Lippman—Phenetol is—

$$\left.\begin{matrix} C_6H_5 \\ C_2H_5 \end{matrix}\right\} O$$

It boils at about 169°. The authors describe a baryta salt of this substance, $(C_6H_4SO_3,C_2H_5O)_2Ba'' + 4H_2O$, a phenetolsulphate of baryta, nearly insoluble in cold, but soluble in hot, water. Phenetolsulphate of lead, crystallising in cauliflower-like masses, soluble in water. Phenetolsulphate of potassium—

$$\left.\begin{matrix} C_6H_4SO_3K \\ C_2H_5 \end{matrix}\right\} O + H_2O$$

is obtained by decomposing the baryta salt by means of carbonate of potassa. The salt obtained is readily soluble in water, and crystallises in needle-shaped crystals.

Structure of Cubical Pyramidal Crystals.—M. Wyrouboff.—This paper is not suited for abstraction, being a strictly crystallographico-geometrical paper.

Cresotic and Salycilic Acids.—M. Vogt.—By means of a complicated process, commenced by acting upon chlorinated xylen with fuming sulphuric acid, an acid has been obtained which is soluble in hot water, insoluble in cold water; soluble, also, in alcohol and ether, and violet-coloured by salts of iron. This acid is composed, in 100 parts, of:—C, 63·1; H, 5·12; O, 31·78. When toluen was treated in the same manner, salicylic acid, $C_7H_6O_3$, was obtained.

Succinate and Benzoate of Isopropyl.—M. Da Silva.—We have already abstracted the contents of this memoir, which was also published in another periodical.

There is added to this number a loose sheet, bearing title—

Ecole Superieure des Sciences Appliquees de Mulhouse.—(*Laboratoire de Chimie*).—From this programme, approved and signed by the Recteur de l'Académie de Strasbourg and other authorities, we learn that there exists at Mulhouse an excellently-arranged school for the education of those who are either to be the heads or future managers of industrial works of various kinds. There is attached to this school a large and well-fitted chemical laboratory, wherein every opportunity is given for practical working, and at a very moderate expense, considering that thirty hours a-week are devoted to chemistry alone. The regular course of this school extends over two years, after which period those who desire it are examined, and certificates are granted, which are considered as rigorous proof of real efficiency. This school is, in miniature, what the celebrated Ecole Centrale des Arts et des Manufactures at Paris is on a large scale. Both these schools were originally established by private enterprise, and have become highly and deservedly esteemed, and are therefore fully approved of by the authorities of the Université de France.

Polytechnisches Journal von Dingler, first number for September, 1869.

This number contains the following original papers relating to chemical science:—

Proper Mode of Applying Zinc-White as a Pigment.—Dr. Dingler.—The author disapproves of the use of any substances containing lead, or any preparations thereof, along with zinc-white. He recommends, instead of the use of ordinary boiled linseed oil, to mix the zinc-white with an oil prepared in the following manner:—200 lbs. of linseed oil are gently boiled, first, for some five or six hours alone, and, next, boiled again along with 24 lbs. of coarsely-broken-up peroxide of manganese for at least twelve hours; in this manner, a very quickly-drying linseed oil is obtained, which is eminently fit for the purpose of being used with zinc-white and other zinc colours. The author lays stress upon the use of old linseed oil, and also upon the care to be taken with the boiled oil, which, unless carefully kept from access of air, becomes thick in a very short time. The boiled oil so prepared ought not to be used in painting with zinc-white, by itself alone, but should be mixed, in quantities of from 3 to 5 per cent, with the raw linseed oil used to mix up the paint.

Optical Milk Test.—Dr. Heeren.—This is a lengthy essay on a subject of great importance. The author points out that chemical analysis only is the proper mode of testing the quantity of butter contained in milk; but he also observes that this requires more knowledge, and also more time than those practically interested in this subject can devote to it. The author then reviews a variety of instruments devised for the purpose of testing milk; among these, M. Chevalier's crëmometer is noticed. In the first place, the awkwardness of this instrument is due to the fact that the milk has to stand therein for at least twenty-four hours; and, although for milk intended for butter-making this is no objection, it is not desirable for daily use. The optical milk-testing apparatus devised by M. Donné, in the year 1843, and M. Vogel, in 1862, are described, and their value reviewed. The general results obtained by this author may be recapitulated as follows:—Skimmed milk contains fat globules of smaller size than unskimmed milk; smaller globules produce a relatively greater turbidity than larger-sized globules. Since the value of the optical milk-test is

based upon the degree of non-transparency, it cannot yield correct results for wholly or partly skimmed milk. Carefully-made experiments prove that the use of M. Vogel's galactoscope gives perfectly correct results, but only for pure and unskimmed milk. By means of a combined optico-chemical investigation, it is possible to detect the precise quantity of fatty matter withdrawn from milk. The increase of the specific gravity of milk by skimming it is in direct proportion to the quantity of fatty matter withdrawn.

Quantitative Analysis of Soap.—M. Span.—Too lengthy to admit of useful abstraction.

Crystalline Coloured Substance Prepared from Mica.—Dr. Tech.—This paper contains the results of researches made with the view to detect the colours applied to minute pieces of mica used for ornamental purposes under the name of *brocate*. The following colours were tested:—*Rose red.*—Proved to be cochineal. *Carmine red.*—The colour is soluble in hot water; ammonia destroys the colour, HCl makes it yellow; colour is soluble in spirits of wine; the colour of that solution is destroyed by ammonia; colouring matter is, therefore, fuchsine. *Violet.*—Hardly soluble in water; completely soluble in water acidified with acetic acid; discoloured by ammonia; turns first green, and then yellow, by addition of hydrochloric acid. *Bright blue.*—Insoluble in water and water acidified with acetic acid; insoluble in alcohol; soluble in aqueous solution of oxalic acid; discoloured by alkalies. *Berlin blue.*—Deep blue; as far as tests could prove, this appeared to be Girard's violet, green, a mixture of aniline blue, and turmeric. Violet blue was evidently obtained with log-wood, and this was also applied to black.

Non-Porous Copper Castings may, according to the editor, be obtained by melting copper in plumbago crucibles previously lined inside with pipe-clay and dried. As soon as copper, while in molten state, is in contact with coal or carbonaceous matter, it yields a porous and spongy casting.

Pharmaceutische Zeitschrift für Russland, August, 1869.

This number contains the following original papers:—

Contributions to a Monograph on Inuline.—M. Dragendorff.—This paper is the first instalment of a memoir on inuline; it contains—(1) an historical introduction; (2) an essay on the different species of plants and parts of plants in which inuline is found; to these belong *Inula Helenium*, L., *Taraxacum officinale*, *Cichorium Intybus*, *Anacyclus officinarum*, *Helianthus tuberosus*. Inuline (also known as *helenin*, *alantin*, *dahlin*, *menyanthin*) is chiefly contained in the roots of the plants alluded to; it is a substance isomeric with, and in its properties similar to, starch, and was discovered in 1804 by M. V. Rose; its formula is $C_6H_{10}O_5$. The paper on this subject is to be continued.

Comparative Essay on the Characteristic Properties of the Halogens and their Combinations, and particularly on Hyperiodic Acid.—M. Ferrein.—This is the last instalment of a very lengthy essay on this subject.

Method for Rapidly Separating the Nitrates of Silver and Copper from each other.—Dr. Palment.—The author had to prepare nitrate of silver from small silver coins which contained a large percentage of copper. The alloy is dissolved in nitric acid; the solution is filtered if necessary, and evaporated until it has the consistency of a thickish oil; when this point is reached there is added to the solution very concentrated nitric acid free from HCl. By this proceeding all the nitrate of silver is precipitated, while nitrate of copper remains in solution. One part of the concentrated metallic solution requires from three to four parts of nitric acid for the complete precipitation of the nitrate of silver; the more concentrated the nitric acid is so much the better, but acid of 1·250 sp. gr. answers the purpose. The solution of copper is decanted off, and the nitrate of silver washed with nitric acid.

Researches on the Excrements of the Silkworms.—Dr. Palment.—These excrements contain 13·33 per cent ash, composed of potassa, soda, a trace of magnesia, carbonic, sulphuric, phosphoric acids, and chlorine. Among the organic substances contained in these excrements, the author found starch, mucus, sugar, tannin, and a peculiar green pigment. The worms had been fed only on the leaves of the white mulberry tree.

On Jantak-Schakar.—Dr. Palment.—Under this name there is sold in the towns of Central Asia a yellowish-coloured, dirty, hygroscopic substance, which is used as sugar, but the author has not been able to learn how it is obtained and from what plant it is derived; he found it did not contain mannite, and yielded on analysis, in 200 parts:—Sugar, 56; water, 11·4; impurities, 21·7; the latter being partly woody fibre, and partly inorganic salts.

Researches on a Petroleum from the Kirgisensteppe.—M. Both.—This oil occurs in wells at a considerable distance from Orenburg; its colour is brownish-black, its consistency like tar; specific gravity, at 14°, 0·87; it contains 17 per cent of water, wherein 0·80 per cent of sulphate of protoxide of iron, readily soluble in ether, alcohol, benzol, chloroform, oil of turpentine, and miscible in every proportion with fatty oils; boiling point, 380°. This oil is purified with great difficulty; it contains 1·87 per cent of sulphur.

Les Mondes, October 7, 1869.

This number contains the following original communications:—

On the Radiant Heat from the Moon.—M. Marié-Davy.—The author says:—I do *not* admit that there is any essential difference between light and heat; I do not say that the *vis viva* of the moon's rays is *nil*, but I say it is so infinitesimally small that it is incapable of raising the temperature of an air-thermometer upon which the moon's rays concentrated by a strong lens were directed 0·0004°; and the heat radiated is not sufficient to raise the temperature 0·000001° when the bulb of the thermometer is directly exposed to the moon's rays. Suppose we apply either a lens ten times stronger than the one we employed, or a thermometer ten times more sensitive, and we thereby magnify the effects of course so that a motion of 1 m.m. will take place which will be very perceptible. If my observations were contradicted by those made by the late Lord Rosse, that nobleman ought to have drawn from his observations the conclusion that the direct rays of the moon were capable of elevating the temperature of a thin blackened object 0·000001°. The sun's rays increase about 12° the temperature of a thermometer placed in an apparatus invented by the Rev. Father Secchi, S. J., the obvious result of my observation alluded to above would lead to the result that the *vis viva* of the sun's rays is 12,000,000 times larger than those of the moon's rays. The moon by no means reflects the total quantity of rays which she receives, and since, in all probability, its radiation is diffuse, it follows that its rays when arriving upon our planet are weakened in the ratio of the square of the diameter of the moon's orbit and of the diameter of the moon itself. The moon's rays are not necessarily of the same composition as those of the sun, and it is a well-known fact that the calorific power is not proportionate to the illuminating power in the sun's spectrum. A common argand lamp placed at a distance of two metres from my experimental thermometer by the heat radiated from it caused the mercury to move through more than 1 m.m. of space, while the moon's image, though giving far more light, did not cause the mercury to move at all.

Naphtha as Fuel for Locomotive Engines.—M. Portski.—This Russian engineer has run a railway train

successfully for a distance of 81 versts* from Charff to Kutschigan, the only fuel applied being raw commercial naphtha, instead of coal, coke, or wood.

The Journal of the Franklin Institute, August, 1869.

This number contains the following original papers and communications:—

Old and New Coal.—Dr. Morton.—The author says:—Attention has been lately drawn to a curious observation, which is given as a fact without sufficient explanation. In one case, where hard coal is used in large quantities for purposes of mere evaporation, it appears that some which has been kept on hand in open piles for five or six months is less effective by from 13 to 15 per cent than that fresh from the pit. The deterioration caused by the absorption of water is, of course, well known, but does not seem to apply to these cases. The fact here alluded to is very well known in this country (England), and also elsewhere on the European continent, but is not quite scientifically explained.

The New Chemical Nomenclature.—Dr. Ott.—This is the first portion of a lengthy paper which the author intends to publish on this subject. He says—"The deficiency of the present system of chemical nomenclature, though immensely felt for many years, has been chiefly brought to light by the astonishing strides of organic chemistry." The author points out the great inconvenience of a nomenclature containing names with seventeen or more syllables; though, in a less distinct manner, this deficiency is also felt in the domain of inorganic chemistry. We meet here such scarcely pronounceable denominations, as "hypersulpho-molybdate of potassa," "sesquibasico-ammoniaco-sulpharseniate of soda," and many others. The author proceeds to point out that the history of the spoken language of chemistry shows more clearly than that of any other science its various conditions in the succeeding stages of progress. The early cultivators of science hid their doctrines under the veil of an obscure figurative language, adopting at the same time particular characters for signifying bodies known to them. In the belief that the celestial bodies exercised a direct influence on terrestrial products, they consecrated the metallic and other substances to the seven so-called planets. As instances, we mention that to Saturn were consecrated the lead, litharge, and agate; to Jupiter, tin, corals, all white stones, and sulphur; to Mars, the iron, loadstone, and pyrites, and so on. Traces of this nomenclature yet remain in such terms as *Arbor Dianæ*, tincture of Mars, Martial pyrites, and lunar caustic. The term *sal* has been used since the oldest times for everything tasting like salt, or even for such substances as carbonate of potassa, which share only some properties with the same—viz., solubility in water, deliquescence, and colour. As instances of figurative expressions, we meet with *aqua ardens*, for alcohol, *lapis aquilinis*, &c. The author proceeds in this manner, passing in review the history of chemistry, but what has been quoted sufficiently exhibits the wide range he has taken for the full treatment of an interesting subject.

Camphoric Acid and some of its Combinations.—M. Fairthorne.—By repeated distillation of camphor with nitric acid, that substance is converted into camphoric acid by absorption of six equivalents of oxygen. The composition of camphor being $C_{20}H_{16}O_2$, that of camphoric acid is $C_{20}H_{14}O_6 + 2HO$. It (the acid) dissolves freely in alcohol and ether, moderately in water, but is soluble in benzol and chloroform. It combines readily with ammonia and other alkalies; the ammonia salt crystallises in silky, star-like crystals. Its aqueous solution behaves, with the substances hereafter named, in the following manner:—With perchloride of iron, a light brown precipitate; no precipitate with the proto salts of iron; with sulphate of copper, a bright green precipitate; with solutions of salts of lead and mercury, dense white precipitates; no precipitation with sulphate of zinc, sulphate of morphia, sulphate of quinine, sulphate of cinchonia, sulphate of magnesia; none, also, with lime-water or soluble salts of silver. The author proposes to use the peculiarly bright green coloured precipitate yielded with sulphate of copper as a test for copper, since even 1 grain of sulphate of copper in a pint of water yields a distinctly perceptible colouration.

* There are in use two kinds of measures called versts in Russia, which differ rather considerably in value, but one of these measures is only used in the Baltic provinces of Russia; the verst more generally in use has a value of 1066·78 metres, the English statute mile being equal to 1609·315 metres; 81 versts is therefore equal to 53·6 English miles.

Cosmos, October 9, 1869.

Test for Berlin Blue.—The late M. Nicklès.—Shortly before his death, this *savant* pointed out that, when woven fabrics dyed with Berlin blue are steeped in a solution of fluoride of potassium, and then submitted to the action of steam, the colour of the tissue is at once discharged. Fabrics dyed with indigo or with aniline blue, when submitted to the same treatment, remain unchanged.

Drying of Wood.—For this purpose, the wood is kept for some hours under boiling water, whereby all its soluble parts are withdrawn. It is next left to dry, and then boiled for some time in a solution of borax, which causes the albumen to become soluble, and to escape from the pores. After this proceeding, the wood is placed in stoves heated by steam, and, in three days after the commencement of this series of operations, it has become quite dry and thoroughly seasoned.

Comptes Rendus des Séances de l'Académie des Sciences, October 18, 1869.

This number contains the following papers bearing upon chemistry and allied sciences:—

Metrical System: Critical Examination of the History of the Metre.—M. Chevreul.—From this lengthy paper we learn that, on the 14th of April, 1790, M. Brisson was the *savant* who proposed that a unit of measure should be taken from nature, by reading, at the Academy of Sciences, a paper "On the uniformity of measures of length, capacity, and weights, and on a new method of constructing the toise to be used as a standard." This paper of M. Brisson was written in consequence of the proposal made by the Bishop of Autun, as a member of the National Assembly, to render a uniform system of weights and measures compulsory by law throughout the entire French Kingdom. The unit of measure of length proposed by M. Brisson was the length of the pendulum beating seconds at the latitude of Paris, which length had been very exactly determined by M. de Mairan, and found to be equal to 3 *pieds*, 0 *pouces*, 8 17-30ths *lignes*, French measure. The Commission des Poids et Mesures, which was appointed after Mr. Brisson had made his proposal, preferred the 10,000,000th part of a quarter of the meridian of Paris as unit. The law of the 18th Germinal of the year III. (April 7, 1795) fixed the length of the metre, provisionally, at 3 *pieds*, 11·442 *lignes*. The law of 6 Messidor, year VIII. (June 25, 1800), fixes the length of the metre at 3 *pieds*, 11·296 *lignes*; the difference being —0·146. This length is the legal length of the metre, and is represented by an *étalon prototype* (invariable standard) deposited with the Academy. From 1836 to 1840, M. Puissant found there was an error in the calculation of the meridian distance of Mountjouy to Formentera; and, accordingly, he found that the length of the metre should be 3 *pieds*, 11·375 *lignes*. The author of this paper comes to the conclusion, however, that, notwithstanding the slight errors found by MM. Puissant, Bessel, and others, the length of the standard metre, which is only 00·079 *lignes* different from the truth, is to be adhered to, also because of the very great inconvenience any change would cause, which is, after all, not essentially required for the uses of daily life.

Making of Standards of the Metrical System:—M. Jacobi.—This Russian *savant*, who, during his sojourn at Paris, was present at this meeting, read a paper on this subject, with the view of generalising the metrical system by the preparation of a large number of new standards made according to those deposited with the Academy, so that every centre of civilisation in Europe and elsewhere may possess one.

Oxidation of Pyrogallic Acid.—M. Aimé Girard.—The author of this paper points out that, when pyrogallic acid is oxidised in the presence of an acid, the products of its oxidation are different from those which are formed when the oxidation takes place in the presence of an alkali. Among the products there is one, $C_{10}H_{16}O_{18}$, which is a beautiful red-coloured substance, analagous to alizarine, and suitable to be used as a dyeing material. This substance is converted into picric acid by the action of nitric acid.

On Esmarkite.—M. Des Cloizeaux.—Esmarkite is a greyish-green coloured mineral; its fracture is conchoid; hardness holds the middle between apatite and orthose; sp. gr. 2·737. Composition, in 100 parts:—Silica, 47·50; alumina 33·70; lime, 15·40; magnesia, 0·56; soda, 1·84; potassa, 0·50; water, 0·94.

Observations of M. Victor Regnault on a Letter from Dr. Bosscha.—This lengthy paper contains a large amount of valuable matter in reference to thermometers, and among it the following:—The mercurial thermometer is not an instrument fit for being applied to the measurement of temperatures in experiments of precision, since it is not comparable (*manque de comparabilité*). Every mercurial thermometer which is to be applied for rigorously-exact experiments should be previously compared with a well-constructed air thermometer, both for degrees of temperature between 0° and 100°, as well as for higher temperatures. The learned author distinguishes three kinds of mercurial thermometers, viz:—Standard thermometers, indicating from −10° to +110°; thermometers for high temperatures, graduated from −10° to +350°, but which should no be exposed to a heat higher than 300°; very sensitive thermometers for calorimetrical use, indicating from 0° to +30°. The mercurial thermometer is only a thermoscope; its indications should be converted into degrees of an air thermometer.

Electro-Chemistry: Physical Method to determine the Molecular Groups which are Decomposed by a Galvanic Current.—M. Bourgoin.—According to this author, the electrolytic decomposition suffered by any compound indicates the grouping of the molecules of which that compound is made up; for instance, when sulphate of soda is decomposed by a galvanic current, it becomes evident, from the products of the decomposition, that the anhydrous salt has suffered dissociation, but not its hydrate; in other words, that the water remains inactive in this process.

Cause of the Ripening of Wines.—M. Béchamp.—The author demonstrates in this paper, at great length, that the same causes which bring on the decay of wine also act in maturing them, and giving them the precious properties recognised as *old*. It is impossible to enter into the details of this subject, which is, of course, practically important only to wine-growing countries; but it appears, after all, that scientific research on this subject is not yet quite exhausted, neither has it so elucidated this matter as to render it of easy practical application.

The American Journal of Science and Arts, vol. xlviii., No. 143, September, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Nature and Duration of the Discharge of a Leyden Jar Connected with an Induction Coil.—Mr. O. N. Rood.—This paper is the first part of a memoir read before the National Academy of Sciences. It is copiously illustrated with well-executed woodcuts, which are essential to the understanding of the paper.

On Durangite, a Fluo-Arsenate from Durango, in Mexico.—Mr. Brush.—The author states that he obtained, from a gentleman residing at San Francisco, a bright orange-coloured mineral, found at the locality above named. The hardness of this mineral was 5, sp. gr. 3·95 to 4·03; it blackens on being moderately heated in a close tube, but regains its colour again on cooling; at a higher heat it fuses to a yellow glass, and gives a faint white sublimate; it fuses readily in reducing flame, gives a strong arsenical odour, and coats the charcoal with a faint white volatile sublimate. The mineral is only partially attacked by chlorhydric and nitric acids, but is completely decomposed by sulphuric acid, with evolution of fluorhydric acid. Qualitative examination showed the presence of arsenic acid, alumina, iron, manganese, soda, lithia, and fluorine. Search was made for other metallic and mineral acids and chlorine with negative result. The following is the result of quantitative analysis in 100 parts:—Arsenic acid, 55·10; alumina, 20·68; peroxide of iron, 4·78; protoxide of manganese, 1·30; soda, 11·66; lithia, 0·81 fluorine, undetermined, but present in very considerable quantity.

Remarks on the Galvanic Battery.—Mr. Hough.

On Nitric Acid and Chlorate of Potassium as an Oxidising Mixture Applicable to Sulphur, Sulphides, Chromium, Arsenic, and Organic Matters.—Mr. F. H. Storer.—This interesting paper will soon appear in full.

Action of Light on Uranium.—Mr. Bolton.—This memoir contains an historical and experimental review of whatever is known in relation to the action exercised by light upon uranium. The paper is too lengthy for any useful abstraction.

Action of Alkaline Nitrites upon Uric Acid and its Derivatives.—Dr. W. Gibbs.—After referring to the labours of M. Baeyer on this subject, the author describes, at great length, a series of experiments made by him. This paper has, however, been forestalled by a communication of the author written to Berlin, and abstracted by us from the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin* (see CHEMICAL NEWS, vol. xx. p. 131, *American Reprint, Nov. '69, page* 311). The original paper was read before the National Academy of Sciences on April 15th last.

On the Meteoric Stone which fell December 5th, 1868, in Franklin Co., Alabama, U. S.—Mr. Brush.—This paper first relates, at length, the history of the circumstances attending the fall of this stone, which, on being received by the author, weighed 615 grms; sp. gr., 3·31; soluble in HCl, only about 26 per cent. Result of analysis, in 100 parts:—Silica, 51·33; alumina, 8·05; ferrous oxide, 13·70: chromic oxide, 0·42; magnesia, 17·59; lime, 7·03: soda, 0·45; potassa, 0·22; sulphur, 0·23; a trace of nickeliferous iron.

On Lesleyite of Chester Co., Penn, and its relations to Ephesite of the Emery Formation near Ephesus, Asia Minor.—Mr. Smith.—The author states that some years ago he analysed and described, mineralogically, under *emery*, the last-named mineral. The lesleyite has great similarity therewith. It is of a pearly white colour, and lamellar in structure; scratches glass easily; sp. gr., 3·15 to 3·20: heated before blowpipe, it becomes milk-white, but does not fuse; it is decomposed with great difficulty, by fusing, by carbonate of soda, even with the addition of a little caustic soda. Ephesite, in 100 parts, contains:—Silica, 30·70; alumina, 55·67: lime, 2·55; soda, 5·52; potassa, 1·10; water, 4·91. Lesleyite, in 100 parts:—Silica, 31·18; alumina, 55·00; lime, 0·45; soda, 1·20; potassa, 7·28; water, 4·80.

Artesian Wells at Terre Haute, Indiana.—Prof. Guyot.—Under the direction and at the expense of M. Chauncey Rose, a well has been bored, and a very exact ac

count has been made of the thickness of the strata passed through and of the fluids met with:—At 840 ft., show of oil; 1276 ft., lubricating oil; 1335 ft., vein of fresh water; 1629 ft., oil vein; 1658 ft., blue sulphur water; 1710 ft., white sulphur water; 1768 ft., more white sulphur water; 1685 ft., large flow of white sulphur water, at the rate of 6000 gallons an hour. The temperature of the water at that depth is not quoted, neither is any further account given thereof; there is no statement, also, of the height above sea level of the surface of the bore-hole on the ground.

Sulphur Deposits of the Island of Saba, Netherlands, West Indies.—Mr. Higgins.—The island of Saba belongs to the volcanic range of the Carribee or Windward Islands. The rock composing almost the entire formation of Saba is trachytic porphyry, which contains glassy felspar and hornblende in crystals, disseminated through a dark reddish coloured base. The sulphur deposit is located on the northern part of the island of Saba, and extends for a distance of more than a mile along the sea line. The stratum of sulphur varies in thickness from 15 to 50 feet; its elevation above sea level varies from 45 to 200 feet. This island has a surface of 16·5 square kilometres (about 9 English square miles, or 5760 acres), and contains 1794 inhabitants; it has been a Netherlands dependency for nearly 200 years, and is a portion of the Government of Curaçoa, along with Aruba, St. Martin (a portion), Bonaire, and St. Eustatius.

Journal für Praktische Chemie, No. 12, 1869.

This number contains the following original paper:—

Analysis of the Medicated Spring of Tonisstein, and of the Chalybeate Spring at the Same Place.—Dr. R. Fresenius.—To many of our readers who have made a trip on the Rhine, the Brohl-Thal will have been a pleasant excursion, and to those who made that trip, the two springs just alluded to will be well known. The author of this paper has divided it into two chief sections and several subdivisions. The medicated spring of Tönisstein has been known even so far back as the time when the ancient Romans occupied that country; and in the year 1864, the Prussian Government caused the spring to be properly cleansed out, and, by means of suitably-arranged masonry and tubing, to exclude any extraneous water. The water of this spring, which is evidently forced up by a pretty strong pressure of a constant stream of carbonic acid gas, is quite clear and very sparkling, owing to the carbonic acid gas constantly escaping from the spring; its taste is pleasant, but at the same time saline. The spring yields, on an average, 4908 litres of water in twenty-four hours, while, at the same time, there escapes a quantity of 650 litres of free CO_2; the temperature of the water was found to be 10·8°, while the temperature of the air was, at the time of making the experiment, 19°; the specific gravity of the water at 15° is 1·00598. The author made, first, a very carefully executed qualitative analysis of this water, and then a quantitative analysis, the results of which are quoted in duplicate—in one case, the carbonates have been calculated as neutral salts; in the other, they are calculated as anhydrous bicarbonates. For each analysis, moreover, the quantities are expressed in duplicate—that is to say, first, upon 1000 parts of water; next, in grains, at 7680 to the Prussian pound. Upon 1000 parts of water, the carbonic acid salts being calculated as anhydrous bicarbonates, there are contained in this liquid:—Sulphate of potassa, 0·09900; sulphate of soda, 0·14063; chloride of sodium, 1·14489; iodide of sodium, 0·00001; bromide of sodium, 0·00080; nitrate of soda, 0·00246; phosphate of alumina, Al_2O_3,PO_5, 0·00013; phosphate of soda, $2NaO,HO,PO_5$, 0·00018; bicarbonate of lithia, 0·00622; bicarbonate of soda, 2·57546; bicarbonate of ammonia, 0·00777; bicarbonate of baryta, 0·00008; bicarbonate of strontia, 0·00007; bicarbonate of lime, 0·55116; bicarbonate of magnesia, 1·63697; bicarbonate of protoxide of iron, 0·02949; bicarbonate of protoxide of manganese, 0·00043; silica, 0·02741. Total solid matters, 6·49816; free, that is to say, non-combined carbonic acid, 2·39334. The following substances are present in this water in quantities too small for determination by the balance:—Fluoride of calcium; borate of soda; organic matter, a mere trace; nitrogen, a mere trace. The Tönisstein chalybeate spring yields, on an average, a quantity of 9072 litres of water every twenty-four hours; this water, on being taken at the spring, is a quite clear, briskly-sparkling, refreshing liquid, yet at the same time ferreous to the taste. There escapes along with the water a considerable quantity of free carbonic acid gas, which amounts to some 6·840 litres during twenty-four hours. The temperature of the water of this spring was found to be 11·5°, while at the time this observation was made, the temperature of the air was 18°; the specific gravity of this water at 15° is 1·00270. 1000 parts of this water contain (the carbonates being calculated as bicarbonates):—Sulphate of potassa, 0·05444; chloride of potassium, 0·03575; chloride of sodium, 0.00911; nitrate of soda, 0·00102; phosphate of soda, 0·00040; phosphate of alumina, 0·00045; bicarbonate of lithia, 0·00048; bicarbonate of soda, 0·89325; bicarbonate of ammonia, 0·00410; bicarbonate of baryta, 0·00011; bicarbonate of strontia, 0·00156; bicarbonate of lime, 0·54075; bicarbonate of magnesia, 1·08154; bicarbonate of protoxide of iron, 0·05007; bicarbonate of protoxide of manganese, 0·00372; silica, 0·04107; entirely free, CO_2, 2·33600. Total, 5·05382. The following substances are present in unweighable quantities:—Fluoride of calcium, iodide and bromide of sodium, organic matter, borate of soda, and nitrogen; of all merely traces.

Analysis of the Lamscheid Mineral Water.—Dr. R. Fresenius.—This paper is not a sterile account of a chemical analysis, but contains, as introduction, a most interesting historical review of a very anciently-known and renowned mineral spring, situated on the so-called Hundsrück, at an elevation of 1100 feet above the level of the Rhine, taken at Boppardt, and on the great Chaussée, leading from the last-named place towards Simmern and Trier, at a distance of about 12 miles from the Rhine. The water bubbles up from a deep depression in Thonschiefer; the well is properly provided with masonry, to protect it from the entrance of extraneous water. The physical qualities of this water are the following:—Perfectly colourless, briskly sparkling, taste very refreshing, acidulous, somewhat ferruginous, and no smell. The well yields, in 24 hours, about 14,000 litres of water; its temperature is 10·2°, when the temperature of the air is at the same time 20°. The specific gravity of this water at 23·7° is 1.00147. The quantitative analysis of this water, its carbonic acid salts being calculated as bicarbonates, yields, for 1000 parts, the following results:—Sulphate of potassa, 0·004918; sulphate of soda, 0·005995; chloride of sodium, 0·005869; bicarbonate of soda, 0·070088; bicarbonate of lithia, 0·001279; bicarbonate of ammonia, 0·000795; bicarbonate of lime, 0·547639; bicarbonate of baryta, 0·000367; bicarbonate of strontia, 0·000074; bicarbonate of magnesia, 0·297382; bicarbonate of protoxide of iron, 0·071386; bicarbonate of protoxide of manganese, 0·006771; phosphate of alumina, 0·000460; alumina combined with silica, 0·000034; silica, 0·034456: free, that is to say, entirely uncombined carbonic acid, 2·818499. Present in this water, but in too small quantity for estimation, are:—Nitrate of soda, iodide and bromide of sodium, organic matter, and nitrogen, all mere traces. The author quotes in this, as well as in the immediately preceding paper, a very interesting series of analyses of other mineral waters, for the sake of comparison. Space forbids us to abstract or quote these particulars here; suffice it to say that the Lamschied mineral water is a most excellent chalybeate, and quite equal to the celebrated chalybeate of Pyrmont.

Asparaginic and Glutaminic Acids.—Dr. Ritthausen.—Among the products of the decomposition by the action of strong sulphuric acid upon legumine and conglu-

tine, the latter substance being the proteine compound met with in almonds and lupines, the author discovered asparaginic and glutaminic acids, and, moreover, a substance the nature of which has not been further investigated. In this essay, the investigation of this subject, commenced some time ago, is fully described. Asparaginic acid exhibits a crystalline body, belonging, in that respect, to the rhombic system, soluble in water and alcohol, and consisting, in 100 parts, of:—C, 36·09; H, 5·26; N, 10·53; O, 48·12. Formula, $C_4H_7NO_4$. This acid, which yields, with the oxides of copper and silver, and also with baryta, well-defined salts, is converted, by the action of nitric acid, into malic acid, $C_4H_6O_5$. Glutaminic acid, $C_5H_9NO_4$, when pure, also exhibits crystals belonging to the tetrahedric rhombic system; soluble in water and alcohol; converted into glutanic acid, $C_5H_6O_6$, by the action of nitric acid.

Asparaginic Acid as a Product of the Decomposition of Animal Proteine Compounds.—Dr. Kreusler.—This author has undertaken, for animal proteine compounds, an investigation of a similar nature as Dr. Rittthausen has done for vegetable proteine substances. The writer of this paper has applied, for his researches, caseine from milk, albumen from eggs, and vitelline from the same. These substances were treated separately with a mixture of 3 parts of concentrated sulphuric acid and 6 parts of water to 1 part of substance; the boiling was continued for eight hours. After the necessary purifying process, and the use of oxide of copper to form salts, the author discovered, with perfect certainty, that asparaginic acid is formed in this instance; but glutaminic acid could not be detected. Animal horn, when treated with sulphuric acid, also yields asparaginic acid.

Analysis of the Iodine Containing Water from the Mineral Spring at Roy, near Freistadt, Silesia.—Dr. Redtenbacher.—10,000 parts of this water contain:—Chloride of sodium, 219·680; chloride of potassium, 2·062; chloride of calcium, 21 384; chloride of magnesium, 7·740; bromide of magnesium, 1·016; iodide of magnesium, 0·319; carbonate of magnesia, 1·832; carbonate of protoxide of iron, 0·505; free carbonic acid, 0·594; silica, 0·554; organic matter, 0·432; total of solid substances, 251·6. The iodine spring at Hallo contains:—Bromide of magnesium, 0·584; iodide of magnesium, 0·426. The iodine spring at Lubatschowitz contains:—Bromide of magnesium, 0·116; iodide of sodium, 0·237. For both these last springs, the quantities quoted refer to 10,000 parts of water.

Annalen der Physik und Chemie, von Poggendorff, No. 9, 1869.

The following are original papers in this number:—

New Spectroscope and Contributions to the Spectrum Analysis of the Stars.—M. Zöllner.—The author describes what he calls a reversion spectroscope, and elucidates its mode of action by relating at length a series of observations made by him with this instrument.

Thermo-Chemical Researches.—M. Thomsen.—The basis of this lengthy essay is thus set forth:—Different acids, when neutralised with the same base, evolve unequal quantities of heat; when, therefore, any acid displaces another acid from its combination with that base, this decomposition will be accompanied either by an evolution of heat or by an absorption of heat, according to the greater or less heat of neutralisation possessed by the free acid or the acid of the salt. The quantity of heat thus evolved or absorbed affords a measure for the degree of decomposition.

Combinations of Alcohol and Water.—M. Mendelejeff.—This paper contains a review of almost every point worthy of notice bearing upon the history of the accurate determination of the density, contraction, and areometrical assay of mixtures of water and alcohol at various temperatures. Another portion of this paper is an essay on the determination of the specific gravity of liquids; to this portion is added the description of a very ingeniously-contrived and neat apparatus, applied for the purpose of taking the specific gravity of liquids, illustrated by a woodcut.

Constant Capillarity of Fused Chemical Compounds.—M. Quincke.

Specific Heat of Air when Kept at a Constant Volume.—M. Witte.

Observations on the Chemical Constitution of Plagioklastic Felspar.—M. Tschermak.—The author does not explain the term *plagioklastic*, but he says the chemical composition of plagioklastic felspars is such that they exhibit isomorphous mixtures of two chemical compounds. [Our readers are reminded that felspar is a mineral of which there exists a great number of varieties; orthoklase, or potash felspar, is $KO,SiO_3+Al_2O_3,3SiO_3$.] The chemical composition of the varieties of this mineral oscillates between two extremes, viz:—Albite, $Na_2Al_2Si_6O_{16}$, in 100 parts:—Silica, 68·6; alumina, 19·6; soda, 11·8. Anorthite, $Ca_2Al_4Si_4O_{16}$, in 100 parts:—Silica, 4·30; alumina, 36·9; lime, 20·1. The author, who is an eminent mineralogist, enters into a lengthy discussion on the mineralogical characters of felspars, and sharply criticises the labours of some other mineralogists; it appears, however, that the chemical analysis of minerals of complicated composition is not a matter of mathematical certainty. As a proof, the author quotes two analyses of the self-same identical substance, made by two noted chemists, wherein the difference of silica amounts to +2·30 per cent; alumina, —1·95 per cent; lime, +0 53 per cent; soda, —1.44 per cent.

Labradorite from the Narodal.—M. vom Rath.

Elements of Terrestrial Magnetism for Gottingen, July 9, 1869, and the Secular Variations.—M. Cohlrausch.—At latitude 51° 31′, 8 N., longitude east of Greenwich 9° 56′, 6, the westerly declination of the magnetic needle was, on the above date, 14° 51′, 7; the inclination, 66° 47′, 4; horizontal intensity, 1·8412.

Reflection of Heat on the Surface of Fluor Spar and other Substances.—M. Magnus.—From this memoir we learn that the following substances reflect, at an angle of 45°, the undermentioned quantities of heat:—Silver, between 83 and 90 per cent; glass, between 6 and 14 per cent; rock salt, between 5 and 12 per cent; fluor spar, between 6 and 10 per cent.

This number contains some papers which have been translated from the *Proceedings of the Royal Society*.

Moniteur Scientifique, October, 15, 1869.

This number contains, among its original communications, the following:—

Manufacture of Alkaline Carbonates, and of Carbonate of Lead, and also other Carbonates, by means of a New Chemical Action.—M. Puissant.—When carbonate of baryta in finely-divided powder is suspended through water wherein, simultaneously, a proportional quantity of sulphate of soda is dissolved; and there is next passed through the liquid a current of carbonic acid, which is meanwhile brought to ebullition, double decomposition takes place, sulphate of baryta is formed, and carbonate of soda is found in the solution; this solution is filtered, and is employed, by means of a similar reaction, for the production of carbonate of lead. This is effected by the addition of sulphate of lead to this fluid, through which, while it is brought to ebullition, a current of carbonic acid is passed; in this manner, sulphate of soda is again formed, and carbonate of lead is deposited. It should, however, be understood that these reactions do not yield—(1) as regards carbonate of soda, that salt at a less cost than the process by which it is usually made; (2) that the carbonate of lead is neutral carbonate, and is not, therefore, possessed of the requisite covering quality of white lead, $3(PbO,CO_2),PbO,HO$, which is a basic carbonate of lead, which cannot even be made by passing into an aqueous solution of sub-acetate of lead, carbonic acid gas; unless, as is done by M. Ozouf,

at St. Denis, near Paris, the quantity of the gas is exactly regulated so as to produce a given quantity of white lead. The two following formulæ exhibit the reactions above alluded to:—

$$BaO,CO_2 + NaO,SO_3 = BaO,SO_3 + NaO,CO_2.$$
$$PbO,SO_3 + NaO,CO_2 = PbO,CO_2 + NaO,SO_3.$$

Quantitative Analysis of Raw Soda (Soda Ash) and Caustic Soda.—M. Jean.—After referring to the volumetrical methods devised by the late M. Gay-Lussac, and pointing out some inconveniences of this method, the author states that he proceeds as follows:—Take 4 grms. of the sample to be analysed, and dry completely at from 110° to 120°; the difference between the weight of the quantity originally taken and the weight after drying gives the quantity of water. Take 1 grm. of this dried material, place it in a glass tube, and pass a current of dry carbonic acid gas over the substance for about an hour; dry it again at 110°, to drive off any mechanically-adhering carbonic acid; place the substance upon a filter, and exhaust with tepid water (32°), until the wash water is no longer precipitated by chloride of barium. The filtrate is collected in a glass balloon with flat bottom, and chloride of barium is added to it. The liquid is left to settle, and, on having become quite clear, is drawn off from the precipitate, by means of a pipette, and the precipitate of carbonate of baryta is collected on a tared filter, washed with boiling water, dried, and weighed. If there happen to be sulphates present, the sulphuric acid is precipitated, along with the carbonate of baryta, as sulphate of that base, and the weighed carbonate of baryta is, therefore, washed with water acidulated with hydrochloric acid, again washed with warm water, and, after drying, weighed. In order to estimate the carbonate of soda, 1 grm. of the dried sample is taken, dissolved in water, precipitated with chloride of barium, the precipitate is collected on a tared filter, and, after having been washed and dried, there is deducted, from the weight found, the weight of the sulphate of baryta. The difference of the weight of the carbonates of baryta found by these two operations indicates the quantity of carbonate of baryta which, by calculation, has to be converted into caustic soda; the second assay gives the quantity of carbonate of soda. In order to estimate the sulphide of sodium contained, 1 grm. of the dried material is again taken; this quantity is dissolved in water, and estimated according to M. Gay-Lussac's method. Let us suppose that this assay has given a quantity of carbonate of soda equal to A, and that our previous operations gave us B of caustic soda and C of carbonate of soda; calculate the quantity of caustic soda, B, into C′, as carbonate of soda—C′ + C = C″, total quantity of carbonate of soda indicated by the gravimetrical assay. The difference between the quantity, A, of carbonate of soda indicated by the volumetrical method, and C″, that found by the gravimetrical method, indicates the quantity of carbonate of soda which has to be calculated as sulphuret of sodium.

Preparation of the Sulphuret of Sodium by a new Process.—M. Jean.—After referring to the difficulties attending upon the preparation of sulphuret of sodium, by igniting a mixture of sulphate of soda and carbonaceous matter, whereby a pure product can never be obtained, the author states that he has found the following process to yield very satisfactory results: 25 kilos. of dry sulphate of soda, 75 kilos. of sulphate of baryta, 10 kilos. of powdered charcoal, and 15 kilos. of powdered pit-coal, are intimately mixed and ignited in an ordinary soda furnace. From time to time, a small sample of the ignited mass is taken, and tested by being dissolved in water, filtered, and to the filtrate a drop of a solution of sulphate of soda is added. As soon as a precipitate of sulphate of baryta ensues, the operation is finished, and the ignited mass is at once transferred to iron vessels, which can be closed with a lid, so that access of air is excluded while the mass cools down; after cooling, the crude sulphuret is placed in wrought-iron tanks, and boiling water is added and ebullition kept up for some time; some sulphate of soda is added, in order to precipitate excess of sulphide of barium. After the liquid has become clear, it is drawn off by means of a syphon, and the solution evaporated to dryness. The sulphuret of sodium obtained by this process is quite free from any undecomposed sulphate, from sulphuret of iron, from silica, and from alumina. By this process, the fire-bricks of the furnace are not acted upon, and the ignited mass is in pulverulent, and not in fused state, and therefore no grinding is required. When, instead of sulphate of soda, sulphate of potassa is used, an excellent sulphide of potassium is obtained, which would be greatly in demand for the manufacture of ferrocyanide of potassium by Géli's process, and for the artificial preparation of water impregnated with alkaline sulphides to be used for bathing purposes.

Purifying Bromide of Potassium.—Dr. Baudrimont.—The bromide of potassium is first qualitatively tested for the presence or absence of iodide of potassium; if that salt happen to be present, it is removed in the following manner:—About 10 grms. of the impure bromide are dissolved in a sufficient quantity of distilled water; a solution of bromine in water is then added in excess, this solution being preferable to bromine itself, as being more readily managed. The liquid is then heated to boiling, and kept so until no more vapours of iodine are given off. The liquid is next evaporated to dryness, in order to eliminate the excess of bromine. In this way a bromide of potassium is obtained free from iodide, but which may yet contain chloride of potassium.

Annales de Chimie et de Physique, October, 1869.

This number contains the continuation of an essay—

New Researches on Thermo-Chemistry.—M. Berthelot.—This paper is divided into several sections, each bearing a separate title:—Decomposition of organic substances by heat; action of the electric spark upon marsh gas; union of nitrogen in free state with acetylen; direct synthesis of hydrocyanic acid; formation and decomposition of sulphide of carbon; chemical equilibrium between carbon, hydrogen, and oxygen; the spectra exhibited by some compound substances when exposed to gaseous mixtures in state of equilibrium; influence of pressure upon chemical equilibria, and especially on the reactions taking place between carbon and hydrogen.

Memoir upon the Determination of the Lengths of the Waves of the Metallic Spectrum Rays.—M. R. Thalén.

Second Memoir on Supersaturation.—M. Lecoq de Boisbaudran.—This paper is the first instalment of a second memoir of the subject named at the head. The author says—"I intend to divide this essay into two sections; in the first of these, I shall record the action of some isomorphous substances upon the supersaturated solutions of the sulphates of the oxides of iron, nickel, copper, cobalt, magnesia, and zinc; in the second portion of this essay will be found described the action of the same isomorphous substances upon supersaturated solutions of two of the above-named sulphates at the same time.

Revue Hebdomadaire de Chimie, October 7, 1869.

This number contains:—

Description of an Air-Pump with Free Plunger.—M. Deleuil.—There is added to this paper a well-executed woodcut. It appears that the vacuum which can be maintained by this air-pump is more perfect than has hitherto been obtained by any ordinary pump of the sort. From recipients of 250 litres capacity, the air can be withdrawn so as to leave only 10 m.m. pressure in a quarter of an hour. There is, with this machine, no need for the use of any oil to counteract friction. The piston (plunger) is double-acting, and it moves as easily at the beginning of the operation of pumping as at the end, with a very rarefied

air. The free space between the plunger and the body of the pump is only 1-50th of a m.m.

October 14, 1869.

This number contains:—

Use of Electric Alarums to Indicate a Certain Temperature.—MM. Besson and Knieder.—The authors have constructed a set of thermometers, through the tubes of which are soldered two small pieces of platinum wire, which are not in metallic contact, until the mercury just rises to the height at which the wires have been placed. Since the latter are in contact with conducting wires to a suitable galvanic apparatus, the instant the mercury makes metallic contact, an alarum is sounded; and this may, of course, by proper adjustment, be effected at any temperature, which, for some purpose or other, should not be exceeded. The instrument is intended for industrial use.

Glycerine Soap.—M. Heeren.—Take 100 parts of oleine of commerce, pour it either in a glass flask (when only a small quantity of soap is intended to be made, or in a cauldron for large quantities), add 314 parts of glycerine of 1·12 specific gravity, heat to 50°, and then add 56 parts of an aqueous solution of caustic potassa (sp. gr. 1·34), and stir the mixture well. The soap is readily and rapidly formed; but the liquid has to be kept at rest for twenty-four hours, and then exhibits a mass of the consistency of honey, in which state it remains. Filtration may be required, but is troublesome and slow.

Test for Albumen.—Dr. Méhu.—Take of crystallised carbolic acid, one part by weight; of commercial acetic acid, the same quantity; of alcohol at 90 per cent., two parts; mix, and keep in a bottle. This fluid is intended to detect albumen in urine; and, for that purpose, to 100 grms. of this liquid (urine) are added 2 c.c. of commercial nitric acid, and next, after thorough mixing, 10 c.c. of the carbolic acid solution. The reaction is stated to be very superior to the use of nitric acid alone.

Cosmos, October 16, 1869.

Liqueur de la Grande Chartreuse.—Dr. Chevalier.—According to this author, this celebrated liqueur, made at the Abbey of the name, near Grenoble, is composed of:—Essence of *melissa citrata*, 2 grms.; essence of hyssop, 2 grms.; essence of angelica root, 10 grms.; essence of best mint, 20 grms.; essence of nutmeg, 2 grms.; essence of cloves, 2 grms.; and 2 litres of rectified spirits of wine, of best quality. The liquid is artificially coloured, either with turmeric or any other suitable material.

Les Mondes, October 14, 1869.

Biography of A. von Humboldt.—M. C. Bruhns.—The Director of the Royal Observatory at Berlin has stated that he intends to publish a scientific biography of von Humboldt, with the co-operation of a great number of German *savants*. The first portion of this work is entrusted to M. Lallemand, who has in his possession a large number of documents and manuscripts, never before published, relating to the late *savant's* life. The second portion of this work will consist of eight separate chapters, each treating of a peculiar science; and each chapter will be edited by the most eminent men in the department of science it treats of.

Removing Stains caused by Photographic Chemicals from the Hands.—M. Fortin.—Referring to the use of cyanide of potassium, and of iodide of potassium, and iodine for this purpose, the author says the first endangers health, and even imperils life; the second is very expensive. The author recommends, instead, to wash the hands with a concentrated solution of either sulphate or chloride of zinc, to which some acid is added at the same time. The deepest and blackest stains should be touched with metallic zinc, whereby the reduction of the oxide of silver or that of the gallate of iron is promoted, and all metallic stains adhering to, or penetrating in the skin removed. Since most of the salts of zinc are colourless, and soluble in water, the hands become soon quite clean. They should then be washed, first with pure water, and next with soap and water.

Preparation of Caustic Baryta for Industrial Purposes.—M. Nicklès.—Four operations are required—(1) Conversion of native sulphate of baryta into sulphide of barium is effected in a continuous manner, in a peculiarly-constructed furnace, the sulphate being previously mixed with a reducing substance; (2) the conversion of the sulphide of barium into hydrate of baryta by means of hydrated oxide of zinc; (3) dehydration of the hydrate of baryta by ignition along with saw-dust; (4) regeneration of the substance which has served for the desulphuration of the sulphide, and obtaining of sulphur.

Cultivation of Cotton in Southern France.—M. Croze-Mugnan.—The author states that, after having made a series of experiments for several years, he is convinced that the cultivation of the *Gossypium herbaceum* will be attended with excellent success in the warmer districts of the south of France.

New Theory of Gravitation.—M. Leray.—We only give the title of this paper, which is well worthy the notice of natural philosophers.

We learn from this paper that the Physical Society at Rotterdam, known as the Bataafsch Genootschap voor Natuur Schei en Werktingkunde, has caused a number of medals to be struck to commemorate the hundredth anniversary of its existence. This medal, which is stated to be excellently well-made, bears upon the obverse the inscription, "Certos feret Experientia Fructus;" upon the reverse, "Societias Philosophiæ Experimentalis Batava Roterrodama Centesimum Natalem Celebrans. In Memoriam S ephani Hoogendijk, Fundatoris. MDCCLXIX—MDCCCLXIX." This Society has a large and very valuable collection of physical instruments, a fine library, and holds its meetings and lectures in the very extensive second-floor halls of the Royal Exchange at Rotterdam.

October 21, 1869.

New Process for Concentrating and Utilising the Sun's Rays.—M. Delaurier.—The author proposes, for this purpose, a truncated cone, open at both ends, and lined inside with polished silver, the sun's rays being admitted by the largest opening. Since the angle of reflection is equal to the angle of incidence, all direct, or reflected rays, will be united at the narrower end of the cone. It is clear that, the greater the length of the cone, the less the opening of its top may be, and the greater will be the concentration of heat. The author's paper, to which a woodcut is added, enters into a discussion on the advantage of this contrivance above the use of lenses and mirrors; and the author very enthusiastically surmises that the heat of the sun's rays may be so concentrated as to serve, instead of the combustion of fuel, for various purposes, especially in countries where, as in Algeria, the heat and splendour of the sun is more permanently felt.

Ancient and Modern Industry of the Chinese Empire.—Among the *accusés de reception*, we find, under the above heading, "d'Aprés des Notices Traduites," par M. Stanislas Julien, et accompagnées de notices industrielles et scientifiques, par M. Paul Champion, Preparateur du Chimie au Conservatoire des Arts et Métiers, Ancien Déléqué de la Société d'Acclimatation en Chine et au Japon; 1 vol., large octavo, 254 pages, and 13 lithographic plates. This is an authentic work, having been faithfully translated from the Chinese language by the best scholars versed in that language in France, while M. Champion has been residing a long time in China, and describes what he has actually seen. The work embraces the following subjects:—Fuel, salt,

lime, sulphur, talc (magnesia minerals), nitrate of potassa (saltpetre), gunpowder, soda and potash, mineral pigments, alum, metals, vegetable colours and dye materials, vegetable wax (from trees), varnishes, oils, candles, ink, paper, printing, vegetable textile fibres, washing of garments, tobacco, papaver and opium, sugar, glucose, preservation of eggs, alimentary *régime* and wages, matches, amber, camphor, rearing of fish, magic lantern, boring of wells, silk, and some minor subjects. The entire work is full of extremely useful information, even for civilised Europe.

NOTICES OF BOOKS.

Field's Chromatography, or Treatise on Colours and Pigments as used by Artists. A new edition, re-written by Thomas W. Salter, F.C.S. London: Winsor and Newton, 38, Rathbone Place. pp. 435; 8vo.

We have, unfortunately, too many examples of the disastrous effects which ensue from the use of certain colours by artists who are unaware of their nature and durability. Many a grand and immortal work of art has suffered irretrievably from the fading of some paints, and the blackening of others, and the effects of damp and impure air upon others. Sometimes colours slowly react upon each other: sometimes bright lead colours pass, in the course of years, into the dingiest of greys, ultimately becoming almost metallically black from the sulphur of the air by which they are surrounded. Now, with all this in view, the appointment of a Lecturer on chemistry to the Royal Academy of Arts has been more than once seriously discussed, and we may hope that, sooner or later, will be carried into effect. In the same direction, and tending to remove such like conflictions of chemical with artistic lore, is Field's, "Chromatography;" and we are happy to welcome a new and revised edition of it. Fortunately its reviser, Mr. Salter, is a chemist; so that artists have already within their grasp a certain application of chemical knowledge to the usages of their craft.

In the preface to this new edition, Mr. Salter informs us that the work has been entirely revised and re-written, "the notices of colours have been considerably extended, their chemical and artistic properties more fully dilated on, and many new pigments of the utmost importance described." Mr. William Winsor was engaged upon the revision of this work at the time of his death, and his *collaborateur* regrets that the intimate knowledge of colours which Mr. Winsor possessed can no longer be applied to the purposes of the revision.

The "Chromatography" is divided into three parts—Part I. "On Colours and Colouring;" Part II. "On Colours and Pigments generally;" Part III. "On Colours and Pigments individually."

In the first chapter, an infinitely too brief history of the prominent phases in painting is given, and allusion is made to the early works on the Egyptians and Greeks. There are, it is asserted, in reality, but three schools of painting—the *Material*, the *Sensible*, and the *Intellectual*. "Modern art, as founded upon the *intellectual* school of the ancient Greeks, became grand, scientific, and severe in the practice of Michael Angelo and Leonardo de Vinci; graceful, beautiful, and expressive in Raphael, Correggio, Domenichino, and Guido; and, aiming at *sensible* perfection, it attained harmony of colouring and effect in the works of Titian and Tintoret; but it sunk into grossness and sensuality while perfecting itself *materially* among the Flemish and Dutch." This is indeed a sweeping survey, so sweeping that no mention is made of the French or Spanish schools. We would not ask it for ourselves, for it is so recently that anything like an English school of painting—and that a mongrel and a bastard offspring—has arisen, that we can well make no demands for recognition; but surely, in the above statement, the name of Fra Angelico de Fiesole should come in between Raphael and Correggio nay, we know not whether he should not be placed at the head of those painters who brought art to its culminating point in regard to the graceful, the beautiful, and the divine. What shall we say to those glorious angels, with wings sprinkled with golden stars, who are ascending jubilantly upon the purple clouds which curl at their feet? Or what shall we say to the serene and infinitely majestic and calm S. John, seated upon the outspread wings of an eagle? The art of to-day is as far behind the art of that day as the science of to-day is in advance of the science of that day. We always think that picture must have reference to Fra Angelico in which we see a monk who, seated in front of his painting, has fallen asleep over his work, while an angel, taking the brush from his fingers, continues that which he has left undone.

Passing on now to the third chapter, which commences Part II., we find some very useful definitions; for example, "By mixing his colours with white, the artist obtains his *tints*. By mixing colours with colours, he produces compound colours, or hues; and, by mixing colours or tints with black, he gets *shades*." Colours themselves are divided into five classes; the Neutral, the Primary, the Secondary, the Tertiary, and the Semi-Neutral. Neutral colours are *black*, *white*, and *grey*. Primary colours are *yellow*, *red*, and *blue*. Secondary colours are *orange*, *green*, and *purple*. Tertiary colours are *citrine*, *russet*, and *olive*. Semi-neutral colours comprehend all the combinations of primary, secondary, and tertiary colours, with the neutral black.

In regard to the "durability and evanescence of pigments," we have a good deal of useful information in chapter 4. The organic colours are most easily affected by light and air; compounds of lead, mercury, and copper by air containing sulphuretted hydrogen. Many colours are altered by the action of lead pigments, and others, again, by ferruginous pigments; finally, the vehicles and varnishes with which colours are mixed often act deleteriously upon the colours.

No less than seven-eighths of the work are devoted to colours and pigments individually considered; and we have here a long list of colours, with an account of their composition and general qualities: let us take the following as an example of the mode of description here employed:—"Burnt carmine is the carmine of cochineal partially charred, until it resembles, in colour, the purple of gold, for which, in miniature and water-painting, it is substituted. It is a magnificent reddish purple, of extreme richness and depth, eligible in flower painting and the shadows of drapery. As it is generally impossible, however, to alter the nature of a pigment by merely changing its colour, burnt carmine is scarcely more permanent than the carmine from which it is produced. If used, therefore, it should be in a body, and not in thin washes, or as a glaze. Durable pigments are admissible in any form; but semi-stable pigments (gamboge excepted) should only be employed in body."

We are glad to notice that descriptions of new pigments have been introduced; thus we have aureolin, thallium red, tungstate of baryta, viridian, brun de mars, indium yellow, and molybdenum green.

The "Chromatography" cannot but prove most valuable to all who are interested in art; and we cordially recommend it even to that dignified and austere body which dictates the art taste of the kingdom.

The Chemical Manufacturer's Plant, as Supplied by the St. Helen's Foundry, Lancashire."

This is an illustrated catalogue of various vessels employed in some of the chemical manufactures, notably in the two greater industries, sulphuric acid and soda. Thus we have pyrites' burner frames, nitre pots, decomposing pans, black ash vats, crystallising pans, &c. Some of the decomposing pans described have a thickness of no less than 7 inches at the bottom; the charge of salt is from 5 to 18 cwts.; and the amount of salt-cake decomposed in a pot varies from 1000 to 2700 tons. The "black ash revolving furnace" is also figured, and appears to be replacing the old hand-furnace in Lancashire and elsewhere.

On Fresh Meat Preservation. By John Gamgee. London: Robert Hardwicke. 1869.

We have, in a pamphlet bearing the above title, an address delivered by Mr. Gamgee before the Board of Agriculture of Amherst (Massachusetts), on a mode of preserving meats for an indefinite time. After many trials, the process which was found to act best was the exhaustion of air from the vessels containing the meat to be preserved, and the introduction of various vapours. Among other substances, the following were tried: Ozone, chloroform, ether, tetrachloride of carbon, bichloride of methylene, carbolic acid, chlorine, hydrochloric acid, and binoxide of nitrogen; but these were ultimately abandoned for sulphurous acid, introduced into the preserving vessel condensed in the pores of charcoal. "I believe," writes Mr. Gamgee, "that charcoal, saturated with sixty-five times its volume of sulphurous acid, will remain, to the end of days, the cheapest, most manageable, and most universally employed antiseptic that the meat preserver can use. It is, perhaps, bold to predict, that which I do with the greatest confidence, that charcoal and sulphurous acid will, in a few years' time, to a great extent, supersede the use of salt." For various reasons, however, sulphurous acid could not be used alone; and the experiments of Hoppe Seyler suggested the simultaneous employment of carbonic oxide, as it was found to preserve the colour of the meat and to expel the oxygen from the tissues; it also acted as a neutral gas to surround the meat in air-tight vessels in place of atmospheric air. The meat to be preserved was placed in a vessel capable of being exhausted by an air-pump; lumps of charcoal saturated with sulphurous acid were then added, and the vessel was exhausted as completely as possible; carbonic oxide was then introduced until the normal atmospheric pressure prevailed within the preserving vessel. Meat thus preserved was found to keep perfectly, not alone in closed cans, but in open vessels, and it could not be distinguished, as regards taste, from recently killed meat. Of course the chief obstacle to the adoption of the process is the expensive nature of the apparatus, and attempts have been made to displace the oxygen from the neighbourhood of the meat, by driving carbonic acid through the preserving vessel by means of a fan: it is obvious, however, that the tissues would still remain charged with oxygen. Whatever may be the value of this process on the large scale, there can be no doubt that few inventions could, at the present time, be of greater value to the human race at large than one which would secure the utilisation, as food, of the thousands of tons of meat which are now wasted in Australia and Texas, and the Argentine Republic. To allow myriads of oxen to attain maturity, and to destroy them for the sake of their skins alone, seems an act comparable to that of the Roman Emperor who caused several hundred flamingoes to be destroyed that he might be provided with a dish of their tongues.

Cleveland and its Metropolis. September 21st, 1869. Middlesborough-on-Tees: Printed at the *Gazette* Steam Printing Works. 1869.

We have received this neat little pamphlet accompanied by a very good map of the district. Its pages contain a very large amount of diversified information, written and compiled with care, and published especially for the information of those members of the Steel and Iron Institute, who, on the occasion of their first provincial meeting at Middlesborough, repair thither and are strangers to the district. We have an historical and archæological review of Cleveland, next a brief but very comprehensive account of the geology of this part of the county of York, followed by a brief history and description of the municipal and parliamentary borough of Middlesborough. The last two pages are devoted to the quotation of analyses of ironstone of this district, coke, best Durham, Weardale limestone, Forcett limestone, pig-iron, No. 1, Acklam Ironworks, and an analysis of grey-coloured slag. The authors of these analyses are Messrs. Crossley and Pattinson. At the end of the work a short description is given of the Acklam Ironworks, owned by Messrs. Stevenson, Jaques, and Co. The map which has been sent along with this pamphlet, has been published by Messrs Gillan, Schmitz, and Co., iron merchants and shipowners, Middlesborough and Glasgow, is excellently executed, and deserves creditable notice, especially since this kind of very useful publications, showing as it does the blast furnaces, rolling mills, etc., is too much neglected in this country. Maps indicating the different local industries of a county are very useful, and the getting up and publishing of them deserve every encouragement.

Elements of Chemistry: Theoretical and Practical. By William Allen Miller, M.D., LL.D., &c. Part III. *Organic Chemistry.* Fourth edition, with additions. Longmans. 1869. 976 pp.

Dr. Miller's works on chemistry have become so thoroughly classical in chemical literature, that, at first sight, it may appear almost unnecessary to notice a new edition of one of them; it will be well, however, as the work has been revised and a good deal augmented, to point out the more important changes and afterwards to give a brief account of the general arrangement and classification of the subject matter.

The principal changes in this edition consist in the uniform adoption of the new notation, together with the system of nomenclature first introduced by Berzelius, then abandoned, and now revived by Wurtz and Cannizzarro, and generally adopted in the chemical world. The metrical system of weights and measures and the centigrade thermometric scale have also, in this edition, been placed side by side with our own scales and measures.

The entire work is divided into fourteen chapters, which gives an average of about sixty-eight pages to each chapter, and there is a further sub-division of each chapter into "parts" and numbered paragraphs. The first and introductory chapter treats of "Organic Analysis, Classification of Organic Bodies, Metamorphosis, Synthesis." Now it has been a good deal contested whether we should not abolish the term "Organic Chemistry," since the old distinction has fallen to the ground, and more than a thousand substances once believed to be formed and capable of formation only in the organisms of plants and animals, have been synthetically prepared in the laboratory of the chemist. Hence, at the outset of this work, we find a statement of the difference between *organic compounds and organised bodies*, the former of which can, in many instances, be prepared synthetically, while the latter are "the result of the action of living bodies upon inanimate matter," and cannot be prepared synthetically. Sugar, oxalic acid, and urea belong to the class of "organic compounds," while muscular tissue and ligneous fibre belong to the class of "organised bodies." As to the line of demarkation between inorganic and organic products, this does not exist, still, as Dr. Miller observes, "it is convenient to sub-divide chemical compounds into organic and inorganic; since those derived from the inorganic world, from the greater simplicity of their composition, afford to the student the most favourable instances for examining the fundamental laws of chemical combination before he proceeds to the investigation of the more complicated products obtained from the operations of the living plant or animal."

The account of the analysis of organic bodies is followed by remarks on the classification of organic compounds, in the course of which the theory of compound radicles and of the Polyad Elements are discussed.

Chapter 2 treats of "The Saccharine or Amylaceous Group: Different varieties of Fermentation," and is divided into four parts. The first is devoted to an account of the different kinds of sugar, and in it will be found (pp. 110 and 111) an extremely useful table giving a list of the various sugars, together with the principal properties and distinguishing characteristics of each. The table commences with

[English Edition, Vol. XX., No. 515, pages 176, 177; No. 518, page 210.

cane sugar, and ends with pinite, $C_6H_{12}O_5$, which has been extracted by Berthelot from *Pinus Lambertiana;* it is a readily soluble substance, with a very sweet taste, not fermentable, incapable of producing mucic acid with nitric acid, and producing right-handed rotation of a ray of polarised light. Part 2 treats of the varieties of starch and gum, and contains an admirable statement of the theory of the action of ferments. Part 3, "Cellulin and Woody Fibre," includes an account of coal and other combustible materials, and useful tables of the analyses of coals. Part 4, "On Fermentation," treats of alcoholic, lactic, and viscous fermentation.

Chapter 3, "The Monatomic and Diatomic Alcohols and Ethers," is divided into seven parts, and extends over 120 pages. It commences with an account of the Monatomic alcohols, passing to the ethers, and to the action of chlorine on ethers and alcohols. Part 5 treats of the "Metallic Derivatives of the alcohols," commencing with zinc-ethyl; then kakodyle, AsC_2H_6, which was the first substance of this class, and was obtained by Bunsen; the name is unfortunate, especially if we are to call it kakodylide of kakodyle—$(AsC_2H_6)_2$ or Kd_2—; we certainly prefer the name *arseniodimethyl, or arsendimethyl.* There are hundreds of compounds in chemistry which might be called kakodyl with as much reason as arsendimethyl. The practice of naming a substance from one of many characteristics which it has in common with other substances cannot be too much reprobated or too soon abandoned.

Chapter 4 treats of the triatomic alcohols; "the Fats and Fixed Oils and Glycerine." Chapter 5 of the "Products of Oxidation of the Alcohols—Acids." The third part is devoted to the fatty acids, and the fourth to certain other vegetable acids, where will be found a detailed description of the modifications of tartaric acid, and mention of the remarkable series of acids obtained by Löwig by treating oxalic ether with sodium amalgam.

Chapter 6, "The Amides and Organic Bases," contains a very detailed account of the organic bases, commencing with the the volatile bases which do not contain oxygen, and first of analine. Among the natural bases we find the cinchona alkaloids, cinchonia, cinchonidine, and cinchonicine; the alkaloids of opium, of the peppers, of the *Strychnos* tribe, and, of tea, coffee, and chocolate. Chapter 7, "Of Essential Oils and Resins," contains Part 1 of Essences, 2 of Resins, 3 of Gluco-ides. Chapter 8 "Of Colouring Matters," contains a list of colouring matters obtained from lichens, and on page 665 we find an "Assay of Lichens for Colouring Matter." The most striking peculiarity of the lichen acids would appear to be their power of etherifying alcohol.

Chapter 9 contains an account of "Products of Destructive Distillation." Chapter 10, "Compounds of Cyanogen; Bases of Animal Origin; Uric Acid and its Derivatives." The cyanides are divided into two classes—"Cyanides which do not contain Electro-negative Metallic Cyanides," among which are the zincic, plumbic, and palladious cyanides, and into "Cyanides which contain Electro-negative Metallic Cyanides," among which are the ferro- and ferricyanides, the nitroprussides, cobalti-cyanides, and iridicyanides. Chapter 11, "Albumenoid and Gelatigeneous principles." Chapter 12, "Chemical Properties of some of the Solids and Fluids of Animal Origin;" and Chapter 13, "On the Nutrition of Plants and Animals." The two last chapters, which, together, extend over nearly 100 pages, will be of special use to medical students and those who devote themselves more particularly to physiological chemistry. Herein are discussed the chemical nature of—(1) the solid constituents of animals—bones, shells, horny matter, fibrous and elastic tissues, and of the components of the brain; (2) "Some Important Animal Fluids"—blood, chyle, lymph, milk, &c.; (3) the liquids concerned in digestion—saliva, gastric juice, bile, with a table of bile products; (4) excrementitious products—urine, excretin, and pus.

The fourteenth and final chapter is devoted to a discussion of "Atomic Volumes, and the Law of Boiling Points," and contains a number of useful and important tables. The first of these (pp. 921-924) shows the density of a number of compound gases and vapours, and is arranged in the following order:—Name of compound, constituents, formulæ, density, calculated when H=1 and when Air=1, and observed in the latter case, and the authority. Next a table (p. 927) of the atomic volumes of elementary bodies; then the atomic volumes of certain oxides, sulphates, chromates, tungstates, carbonates, and nitrates, and of liquids of analogous composition. The remainder of the chapter is devoted to Kopp's law of boiling points. The fundamental proposition of this law is, as is well known, that for every addition of CH_2 in the empirical formula of compounds of ethyl and methyl, a rise of temperature of about 20° C. takes place in the boiling point; it has further been observed, as a general result of observation, "that the boiling point of a normal acid is 63° C. higher than that of its methylic ether, 44° C. higher than that of its ethylic ether, and 13° C. lower than that of its amylic ether the boiling point of an alcohol of the form $C^nH_{2n}+_2O$; is about 40° C. lower than that of its corresponding acid $C^nH_{2n}O_2$; a compound ether of the form $(C_nH_2{}^n+_1C^nH_{2n}-_1O_2)$ boils at about 82° C. below the acid $(C_nH_{2n}O_2)$ which is isomeric with it." It is notorious, however, that very considerable discrepancies have been observed as regards the accuracy of Kopp's law, whether arising from inaccuracy of observation or from a defect in the law remains to be proved. Kopp has well observed in regard to these discrepancies "That it must not be assumed that the boiling points of liquids, when compared at *any* given pressure, will always exhibit the same differences as they do when compared at the average pressue of 30 inches (760 m.m.) of mercury. It does not follow, for instance, though the boiling point of ether is 79·5° below that of alcohol under a pressure of 30 inches, that under a pressure of 15 inches, the difference between these boiling points should still be 79·5°; since it is well known that what is called Dalton's law, viz., 'that all liquids at equal distances from their boiling point emit vapours of equal tension' is not correct."

The excellence of Dr. Miller's "Organic Chemistry" is so well recognised that it does not require one word of praise here. The very fact of its having reached a fourth edition (which is the fate of few large chemical works in this country), speaks for itself. Since Dr. Miller is constantly engaged in the teaching and the practice of chemistry, we are insured in his works the very newest matter, whether of theory or experiment. Thus we notice, in this edition, an account of the very recent researches of Messrs. Matthiesson and Wright on morphia and codeia. The constant reference to researches is of especial value, and if the year were more often added to the number of the volume and page of the work quoted, would be of still greater service. We regret to notice a somewhat large list of *errata* for a fourth edition, for although the corrections may be made once for all in ink, a work is always somewhat disfigured thereby. The use of a variety of types is now becoming more or less general in scientific works, especially on the continent, and when this can be done it certainly greatly facilitates reference; the broad thick letters and numbers are especially useful for the heads of paragraphs, while salts may be advantageously printed in small capitals, or with some other distinctive type characteristic: if in a later edition of the work we are considering this could be done, we think it could be consulted with greater readiness. We are almost surprised to find that Dr. Miller, whom we have been wont to account one of the more conservative chemists, has not only fully adopted the changes in the atomic weights and in the formulation of compounds, but has also introduced the changed names of substances, or, at least, one set of changed names. Thus it surprises us to find him speaking of "Plumbic Chloride," "Zincic Oxide," "Sodic Sulphate," and "Palladious Cyanide." The adoption of these terms by so eminent an authority will do much towards making them universal in the chemical liter-

ature of this country. We cannot help thinking sometimes, when we notice the extent and the variation of these changes, of the future of chemistry. If the science progresses in the next quarter of a century as much as it has in the last quarter (and there seems no reason to doubt that it will), there must of necessity be great and portentous changes. We cannot yet treat the facts of chemistry in a dogmatic and final manner. We cannot lay down such propositions as did Euclid of geometry; there is no absoluteness at present in our science; there is nothing of which we can speak with the same precision as we speak of the relation of the circumference of a circle to its diameter. And so long as this is the case some are of opinion that any changes tending to produce complexity should be avoided until their adoption has become, by the general consent of the chemical world both at home and abroad, a matter of absolute necessity.

Exercises in Practical Chemistry. By A. VERNON HARCOURT, M.A., F.R.S., and H. G. MADAN, M.A. Series I., *Qualitative Exercises.* Oxford: Clarendon Press. 1869. 335 pages.

THIS joint work of Messrs. Harcourt and Madan is the last volume which has appeared in the very useful "Clarendon Press Series" of Messrs. Macmillan and Co.; and it forms the first half of a work which is to include quantitative analysis. The object of the work "is to furnish a systematic course of study to those who are beginning to learn chemistry practically;" and, with this in view, the authors have detailed, with much care and precision, the nature of, and the mode of manipulation with, all the more general apparatus, and have given in the Appendix suggestions for the construction of the simpler apparatus.

At the outset, we notice, under the head of "Memoranda," a series of ten aphorisms, embodying, in very terse language, rules for the attainment of the exactness and precision of action, and of the attitude of mind which must accompany chemical work. Such are:—

1. "Be orderly and neat in manipulation. Cleanliness stands at the head of the chemist's scale of virtues. All messes must be cleared away with the zeal of a sanitary inspector.

2. "Do not begin work in a hurry.

3. "Be economical of materials.

6. "Do not think merely of what will *do*, but what is *best*, of the means at your disposal.

10. "Finally, do not look upon chemistry as a mere amusement—as a means of getting up a few explosions, creating a few unsavoury smells, producing a few striking changes of colour. Chemistry is worthy of better treatment. It is no longer a 'black art,' but a refined science, and should be thoughtfully and reverently studied."

After the "memoranda," we have a list of the apparatus, and of the substances required for the work described. The illustrations of apparatus are, for the most part, drawn on the block direct from photographs taken by one of the authors. We do not notice the introduction of any new or modified form of apparatus; and that which is described is (as it should be) of the very simplest and cheapest description. Part I. is devoted to "Experiments on the Preparation and Properties of Substances," and this is commenced by an account of different operations, such as—"Fusion and Granulation;" "Glass-working;" "Solution, Evaporation, and Crystallisation;" Precipitation and Filtration;" "Distillation;" "Use of the Pneumatic Trough." Each of these is described with the utmost detail; for instance, more than two pages are devoted to the method of boring a cork, and more than three to the use of the pneumatic trough.

Section 2 treats of the "Preparation and Examination of Gases;" and each *exercise* is conveniently headed by a list of the apparatus and materials required for the preparation of the particular gas about to be described, even down to "cedar matches," and "a jug of water." We do not think that the list of experiments is at all sufficient; nor does there seem to be any effort to introduce new or modified effects. In the experiments in connection with oxygen, the burning of sodium in that gas is not mentioned; yet this is surely an experiment of the utmost importance, to it behoves the teacher to show the inappropriateness of the name oxygen, inasmuch as, by its combination with substances, are produced, not alone acid compounds, but also some which are neutral and alkaline. Again, the burning of naphthaline in oxygen is a very notable experiment; as, also, the burning of thallium, zinc, and aluminium. Hydrogen, nitrogen, and the protoxide and dioxide of nitrogen are next described; and an account of the collection of gases by displacement heralds "Carbon Dioxide," in the account of which we are glad to notice the capital experiment of burning magnesium in a bottle of that gas, which is a far easier plan than the old arrangement of a bulb-tube and red hot potassium. To separate the black flakes of carbon from the white flakes of magnesia, the bottle is to be rinsed out, and hydrochloric acid added to dissolve the magnesia. In order, follow—"Carbon Protoxide," "Ammonia," "Hydrogen Chloride," "Chlorine," "Ethylene," and "Sulphur Dioxide." Remembering to how large an extent the work before us will be used in schools, and the usual recklessness of boys, we think it behoves the authors, in the next edition, to add special precautions in regard to explosive substances. For instance, we do not think that nearly enough has been said about the danger of exploding ethylene with oxygen gas, from the careless management of which experiment a really serious accident might without difficulty arise.

Section 3 treats of the "Preparation of Reagents used in the Laboratory." The preparation of solutions of hydrogen sulphide, of chlorine, of chloride of tin, and of "Hydrogen and Silicon Fluoride," is here described. Then follows an extremely useful chapter on the "Preparation of Normal Solutions of Reagents," in which no less than thirty-seven solutions are described.

Section 4 treats of "Experiments with the Mouth Blowpipe;" and Part 1 is concluded by Section 5, wherein is detailed an "Examination of the Properties of the Principal Radicles and their Salts." Nearly one-third of the book is devoted to this subject; and explicit accounts are given of the properties and mode of examination of all the substances in most general use in the laboratory. The following may be taken as an example:—

"Place a bit of magnesium-ribbon, about 25 c.m. in length, in a test-tube, and pour on it some dilute hydrogen sulphate. Hydrogen gas will be evolved with effervescence, and the metal will gradually dissolve. When the action has ceased, pour off the liquid into a small porcelain dish, and evaporate it down until it begins to crystallise. Long prismatic crystals of magnesium sulphate (Epsom salts) will be deposited in abundance as the solution cools; these should be re-dissolved in about 20 c.c. of water, and separate portions of the solution tested as follows:—

(*a*) "To a portion, add a drop or two of solution of ammonium sulphide. No precipitate will be formed, since magnesium sulphide, unlike zinc sulphide, is soluble in water."

The other usual tests follow—sodium carbonate, ammonium carbonate, ammonia and ammonium chloride, and the blowpipe test with cobalt.

Part 2 treats of the "Qualitative Analysis of Single Salts," and is divided into six sections, of which the first explains the general nature of the analytical course; the second, the "Preliminary Examination of the Substance;" the third, the "Examination of the Solution of a Single Salt for a Metal;" the fourth, the "Examination of the Solution of a Single Salt for Non-Metallic Radicle;" the fifth, the "Examination of an Insoluble Substance;" and the last, an "Example of the Analysis of a Single Salt." A general grouping of substances is given in the first section, together with a table showing the distribution of the principal metals into groups for the purposes of separation. The preliminary examination is discussed under thirty-one separate heads, and is very clear and precise. The

whole subject of Part 2 is divided into seventy-four minor heads, and these are distinguished by bold and black figures placed near the margin. The extent to which printers' type can indicate a desired difference by its own difference of form is surely well shown in this work; for, in a single page, we observe no less than *nine* different kinds of type.

The work is concluded by six short appendices, whereof the first contains "Suggestions for the Construction of Chemical Apparatus;" and here we find such proposals as the conversion of a biscuit-tin into a pneumatic trough, of a door-handle into an Argand burner, and of a tobacco-pipe into a deflagrating spoon. Without doubt, it may be well sometimes for the student to exercise his ingenuity in this way; but, when we remember the extreme cheapness of all the more ordinary chemical apparatus, we do think a great deal of time is often wasted in the attempt to construct that which, after all, is but a clumsy and short-lived piece of apparatus. Appendix B discusses the recovery of gold, platinum, and silver from their residues. Appendix C contains a very useful table of the solubility of a number of salts, on the authority of Storer's "Dictionary of Solubilities." Appendix D contains "Tables of Weights and Measures." Appendix E treats of "Thermometric Scales." And, finally, Appendix F discusses the nature of chemical symbols, which are very sparingly used throughout the work. The index is short, but is, perhaps, sufficiently long for a book which, to a certain extent, constitutes its own index.

Regarding the book as a whole, it may be said to contain a large and varied amount of information; the matter is condensed as much as possible, although considerable minuteness of detail is frequently apparent. We confess that the arrangement often appears to us to be complex, and we do not grasp the design which the authors had in view in certain of their modes of arrangement. Indeed, every new work on Chemistry appears to us more complex than that which preceded it; Bloxam's "Laboratory Practice" is surely a less complex (but in all fairness, be it remembered, also a less comprehensive) work than that of Messrs. Harcourt and Madan; while, to our mind, the least complex work of all is "Bowman's "Practical Chemistry." It will be borne in mind that we speak here solely of arrangement of matter and simplicity of style. Perhaps we are too conservative in all this; perhaps we like too much *stare super antiquas vias*, but, truly, we think that much of the chemical literature of the period is characterised by unnecessary complexity and obscurity. At the same time it is undeniable that Chemistry itself is advancing in the same direction, and so long as this continues to be the case, we cannot expect to have a different literature. The importance of an extreme simplicity in the mode of teaching a new and difficult science to boys cannot be exaggerated. A boy with some glimmer of a taste for science will, if he meet with a rebuff at the outset, probably abandon the study altogether. The questions which boys ask after hearing a lecture indicate how they often unwittingly create difficulties, and in the abstruse branches of analysis these difficulties must more frequently arise. Let it be remembered, however, that Messrs. Harcourt and Madan have had much experience in science teaching, and we may feel very sure that they have embodied the sum and substance of that experience in the work before us. They are both well qualified to write on the subject, and they have done justice to it. Their work appears very opportunely, for now, more than ever, is the establishment of school laboratories and science classes receiving the attention of all who are interested in the educational progress of this country, and we are well assured that the work we have been considering will be much used both in the higher classes of our schools and in our universities.

CORRESPONDENCE.

Ink.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xx., p. 155, *Amer. Repr. Dec.*, 1869, *page* 356), you give M. Voigt's recipe for "a very black and very cheap ink." The objections to it seem to me to be these—(1) It involves a number of unnecessarily troublesome processes; (2) it requires the use of sulphate of copper, which leads to the deposit of copper on steel pens, and so makes them useless; (3) it prescribes corrosive sublimate, which is not good for little boys, who will suck their pens; (4) it recommends logwood, which gives a brownish tone to ink.

For any one who wishes to make his own writing-ink, I do not know an easier or better method than that adopted by the late Professor Daniell, of King's College. He put into a stoneware jar 1 gallon of soft water, ½ lb. of bruised nut-galls, and next day 6 ozs. of green vitriol, 6 ozs. of gum-arabic, and 4 or 5 drops of kreosote. The bottle was then corked, and left in a corner of the room for two or three weeks, so that, once in two days, or so, it might remind the owner that it wanted a good shaking. After this, it was left a few days, and then the clear liquor was decanted off for use. This formed a very black, a very cheap, and, what is more, a very durable ink.

I have letters from Professor Daniell written with such ink a quarter of a century ago, and from Snow Harris (who used the same ink), of the same date, and they form a good written character of this useful black servant.—I am, &c.,

C. T.

September 26th, 1869.

Blowpipe Chemistry.

To the Editor of the Chemical News.

Sir,—In my letter on the 17th of June, to your address, I state as follows:—"I reflected, however, that borax, being a compound salt, could scarcely be expected to give uniform results chemically, either as regards crystallisation or any other operation." The same reflection, together with a strong wish to obtain trustworthy reactions by the blowpipe through which the alkalies and alkaline earths could be detected, led me to try the colouration of Co solution with pure boracic acid, adding the alkali or earth to be experimented upon by traces at a time. I succeeded beyond my utmost expectation; the CoO, indeed, was scarcely at all dissolved in the pure BO_3; but I observed with my magnifying-glass spots of deep red-violet colour upon the cooler part of the platinum wire, which promised good results; and I found that, upon the addition of a trace of potash or soda, taken up on the hot bead, the CoO quickly dissolved, producing, in both cases, a pretty but light pink colour. I then generally (for I have made hundreds of experiments, with the detail of which I will not fatigue you) took upon the bead one more drop of Co solution, which deepened the pink colour, and showed a fine mauve-blue while hot. By the gradual addition of soda ($NaOCO_2$) to this, both the hot and cold beads were deepened in their tints, the former showing, for a moment, a deep blue-violet, and the latter remaining a splendid violet or purple colour. At last, the bead thus treated remains blue, both while hot and cold, and the amount of Na taken to effect this shows, I presume, pretty exactly that contained in borax.

The boracic acid cobaltine bead, treated in a similar way with potash, shows the same series of colours, but the potash blue is deeper, and has a dark violet tinge in it, which the soda blue has not, except when held against the flame of the lamp. On the addition of soda to a potash cobaltoboracic acid bead, this violet-blue is not changed, but even deepened; and the addition of potash to soda in a similar bead has a like effect. The addition of carbonate of lime to a boracic acid bead, with a drop of Co solution, produces a mauve-blue, opaque bead, magnesia a lavender-blue, opaque bead, both going through the gradations of pink, &c.

Fluor spar produces a clear bead; after a time, mauve-blue; so that the fluorine assists the boracic acid to dissolve

the lime. Magnesia, assisted by a trace of potash or soda, may, by gradual addition, be made to go through the usual gradations of pink, &c., in a clear bead, until a mauve-blue is attained.

It will be proper here to detail two experiments showing the quantity of potash and soda taken respectively to satisfy an equal quantity of BO_3.

(1) "Measured very carefully half of 5 measures of BO_3, forming a bead about three-fourths the diameter of glass tube. Filled five measures with $NaOCO_2$; took a trace on hot bead, and added drop of Co solution; light pink, no undissolved Co discernable. Another drop Co solution; mauve hot, amethyst colour cold. Another trace Na; blue-mauve hot, dark purple cold. Trace more Na; lime-blue hot, blue-purple cold. Trace Na; deep mauve-blue hot, deep purple-blue cold. More Na; a little darker colours than before. More Na; mauve-blue. More Na; held against a bead of cobaltine borax, the blue still appeared mauve. More Na; not borax-blue yet. More Na; cobalt borax-blue. It took three-fourths of 5 measures (75 milligrammes); but, as it was a hydrated salt, containing, I should think, half its bulk in HO, I took half of this, or 35 milligrammes, to be the amount of $NaOCO_2$ taken to satisfy 50 milligrammes of boracic acid.

(2) Took half of 5 measures to form BO_3 bead, same size as last. Added drop Co solution and trace of $KOCO_2$ from 5 measures: pink, deeper than soda first trace. Added trace KO; light mauve hot, and light pink cold. Added drop Co solution; dark mauve hot, darkish purple cold. Trace KO; very dark blue hot, dark violet cold. Trace KO; dark mauve-blue hot and cold. Trace more KO; darker blue than last. Trace more KO; deep violet-blue, potash blue. Took half of five measures (50 milligrammes), and, as it was also a hydrated salt, with less HO than the other, I estimated the quantity taken to satisfy the BO_3 as three-fourths of that, or 37·5 milligrammes; but I consider that too much, as I overdid the blue colour, and the KO was evidently more energetic in combination with BO_3 than Na, so that I should think it forms, with that acid, a triborate. I cannot procure caustic soda here, or would not have experimented with the carbonates of those alkalies.

(3). Filled five measures again, and took half to form a bead of BO_3, same size as before. (NB.—The loops of my platinum wires are all twisted of the same diameter). Filled five measures with $CaOCO_2$. Added trace Ca to boracic acid bead, with one drop Co solution; bead pinkish, with undissolved Co in spots. Trace Ca; opaque lavender bead. Trace Ca; bead still opaque, of a blue lavender colour, with spots of undissolved CoO, so added trace KO to clear it, and added trace BO_3 to make up for the KO; bead dark and amethyst. Trace Ca; dark mauve hot, dark amethyst cool. Trace Ca; the mourning-violet colour cool. Trace Ca; deeper colour. Trace Ca; dark violet-blue, lime-blue. Took three-fourths of 5 measures (NB. This powder was extremely fine and dry, so that the above amount, 75 milligrammes, is, if anything, too little). I then made every effort, trying carbon, crystals of a solution of boracic acid in nitrate of cobalt, &c., to get the BO_3 to dissolve the CoO without the addition of an alkali, convinced, if I succeeded, I should get the beautiful wine-red or blood-coloured purple I had observed on the cool part of the platinum wire. I plunged the hot bead into cold water to cool it; I placed two small pieces of platinum wire in its centre for the same purpose, but without effect; and, as you will see from what follows, I found that BO_3 even acted as an alkali itself. Its energies are certainly feeble, and, even with a little KO, it failed to dissolve Cr_2O_3.

Reasoning analogically, I now concluded, as microcosmic salt gave a blue with Co solution not to be distinguished from that of borax, to attempt similar experiments to the above with pure or glacial phosphoric acid. I thought, at first, that I should have to make this myself, but was lucky enough to find two kinds in a chemist's shop here, who uses it in the preparation of some food. The kind which looked the purest, being like ice, I found, on being heated, gave off a smell of ammonia, and became so fluid as to drop off the platinum wire. I applied Co solution to what remained, and it immediately became blue—I presume, from the soda contained in the bones from which it was made. The other, in sticks like those of phosphorus, acted most energetically, and at once dissolved almost any quantity of CoO to a magnificent red-purple bead—the very colour I tried to get out of BO_3 and CoO in vain. On mixing BO_3 with this red-purple bead in considerable quantity, I obtained a blue so deep that it appeared opaque, but, once seen, far surpassed in splendour of colour that of cobaltine borax.

I have not space or time to relate now my experiments with PO_5; but one fact is too important to omit, viz., that, with a slight trace of MnO_2 in the phosphoric bead, I obtained, by the persistent addition of soda, a rich brown colour, without any amethystine tinge, while potash gave, with the same oxide, an amethyst, with a far more purple tint than that of either the borax or microscomic bead does with manganese.—I am, &c.,

W. A. Ross.

Simla, July 15th, 1869.

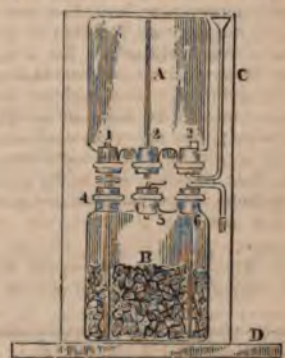
LABORATORY NOTES.

ON A CONVENIENT FORM OF

SULPHURETTED HYDROGEN APPARATUS FOR LABORATORY USE.

Of the many forms of apparatus that have been proposed for the generation of sulphuretted hydrogen, very few allow themselves to be changed so as, at a moment's notice, to give a steady and constant stream of the gas without a slight but continuous escape taking place. In large laboratories, where many analyses are being carried on at the same time, and a large amount of the reagent used, the form described by Fresenius in his "Qualitative Analysis," similar to the hydrogen apparatus used in making sulphuric acid chambers, is all that can be desired. Lead, however, is scarcely a suitable material for smaller apparatus, and glass must be substituted. The old form, with three bulbs, is sometimes used, but these are expensive, and objectionable, inasmuch as, when charged, but not in use, the acid is only prevented from falling and acting on the sulphide by the volume of gas below, so that a variation in the temperature, or very slight leak in the connections, or even the porosity of many varieties of india-rubber tubing, is sufficient to keep up a constant action. The form to be described combines, on a small scale, the advantages of both.

In the figure, A and B are two Woulf's bottles, each furnished with three necks, one held over the other by means of two wooden supports, passing between the necks, and so shaped as to fit the bottle, firmly secured to a backboard, C, which, again, is strongly fixed to the baseboard, D. A may be rendered more secure by further connecting it with the



backboard at the top. Each of the necks is fitted with a good cork. A short and rather broad tube is inserted in cork No. 1. No. 4, opposite to it, is furnished with a tube of equal size, reaching to the bottom of B. These tubes are connected by means of a piece of india-rubber tubing, with sufficient space free to allow of the latter being closed by a Mohr's pinch-cock. Through No. 2 passes a small tube, reaching to the top of A and terminating immediately below the cork. In No. 3 is inserted an acid-funnel, the tube reaching on the inside just above the cork, and bent upward outside, so that the funnel shall be on a level with the top of the apparatus. Through number 6 passes a tube long enough to reach to the bottom of B; the outside end of this is bent downwards, and terminates in a small piece of india-rubber tubing, which can be plugged with a piece of glass rod. The central neck is furnished with an exit-tube for the gas, the stream from which must be regulated by means of an india-rubber tube and screw clamp. About one-third of the lower bottle is filled with small pieces of flint, and on this the sulphide of iron is placed.

To charge the apparatus, the tube at No. 6 is closed, and sufficient acid poured down the funnel to cover the sulphide. When the egress of the gas is stopped, the liquid passes up through No. 4 to A, the air in the latter escaping through the small tube at No. 2. When all the liquid has ascended, the connecting tube at No. 4 is closed by means of the pinch-cock, and the lower bottle relieved from the pressure. When the acid becomes exhausted, it may be drawn off by removing the stopper at No. 6, when, if the liquid is in the upper vessel, it will at once run off: if, however, the exhausted solution is in the lower vessel, it must be removed by blowing in at No. 5. The outside limb of No. 6 may be made long enough to act as a syphon, when the necessity of blowing would be avoided: it would then, however, be easily broken.

E. W. Parnell.

Runcorn, Sept. 25th, 1869.

MISCELLANEOUS.

Discovery of Bismuth Ore.—On an estate belonging to M. Carnac, near Balhannah, South Australia, a very valuable lode of bismuth has been found, while some miners were seeking for copper ore. Since bismuth has very much increased in price, and is increasingly in demand, this discovery is a highly welcome one.

Incrustations in Boilers may be prevented by introducing raw potatoes, which cause all solid matters to be precipitated at the bottom of the boiler in a fine powder, leaving the sides perfectly free. The experiment was tried with an engine of 8-horse power, into the boiler of which ten kilogrammes of potatoes per week were introduced through the safety-valve. Every week, when the fires were extinguished, the deposit was removed previous to the introduction of a fresh supply of potatoes. On examining the boiler after fourteen consecutive months of work, no traces of incrustation were perceptible; the appearance of the plates was blackish and slightly greasy, and the corners of the joints were in the same state as when first made. Refuse leather-cuttings from the tanneries will answer the purpose equally well.—*Annales de Génie Civil.*

Electro-Plating of Paper or other Fibrous Material.—The *Druggist's Circular* says—"A mode has been devised for depositing copper, silver, or gold, by the electric process, upon paper, or any other fibrous material. This is accomplished by first rendering the paper a good conductor of electricity without coating it with any material which will peel off. One of the best methods is to take a solution of nitrate of silver, pour in liquid ammonia till the precipitate formed at first is entirely dissolved again; then place the paper, silk, or muslin for one or two hours in this solution. After taking it out and drying well, it is exposed to a current of hydrogen gas, by which operation the silver is reduced to a metallic state, and the material becomes so good a conductor of electricity that it may be electro-plated with copper, silver, or gold, in the usual manner. Material prepared in this manner may be employed for various useful and ornamental purposes.

Permanent White, which is necessary in the manufacture of ultramarine, may be formed by adding to the washing waters of that dye sufficient chloride of barium to render the liquid no longer turbid. The precipitate, which is heavy, and falls quickly, may be deprived of a bluish tint by depositing a portion first, with which the ultramarine held in suspension also settles.

Method of Producing upon Iron a Durable Black Shining Varnish.—M. Weiszkopf.—Take oil of turpentine, add to it, drop by drop and while stirring, strong sulphuric acid, until a syrupy precipitate is quite formed, and no more of it is produced on further addition of a drop of acid. The liquid is now repeatedly washed with water, every time refreshed after a good stirring, until the water does not exhibit any more acid reaction on being tested with blue litmus paper. The precipitate is next brought upon a cloth filter, and, after all the water has run off, the syrupy mass is fit for use. This thickish magma is painted over the iron with a brush; if it happens to be too stiff, it is previously diluted with some oil of turpentine. Immediately after the iron has been so painted, the paint is burnt in by a gentle heat, and, after cooling, the black surface is rubbed over with a piece of woollen stuff dipped in, and moistened with linseed oil. According to the author, this varnish is not a simple covering of the surface, but it is chemically combined with the metal, and does not, therefore, wear off or peel off, as other paints and varnishes do, from iron.

Oxidation of Ammonia.—Chemists are acquainted with the experiment for showing the oxidation of ammonia, in which a red-hot spiral of platinum wire is introduced into a bottle containing a thin layer of strong ammonia on the bottom; white fumes appear of nitrite and nitrate of ammonia. This experiment may be made far more conspicuous in the following manner:—Take a piece of combustion tube, about 40 or 50 centims. in length; place in the middle thereof a layer of 4 or 5 centims. of platinised asbestos. At one of the open ends of the tube a rolled-up piece of blue, and at the other end a similar piece of red, litmus-paper is placed; the last-named open end of the tube is connected, by means of properly arranged tubing, with a flask containing liquid ammonia; the other open end of the tube, where the blue-coloured litmus-paper is placed, is similarly connected with a flask filled with air. The platinised asbestos is next heated to redness, and kept in that state by suitable means. By the employment of a properly arranged tube, a current of air is slowly blown through the flask containing ammonia; when this is continued for a few moments the red litmus-paper will be observed to become blue, and the blue litmus-paper, at the other open end of the tube, will be seen to become red, whilst, at the same time, there will be deposited at the colder portions inside the tube, behind the red-hot platinised asbestos, a broad white ring of nitrite and nitrate of ammonia, while red vapours begin to fill the empty flask. When the gas, after having passed over the platinised asbestos, is made to come into contact with a strong solution of protosulphate of iron, to which some few drops of sulphuric acid have been added, this solution soon becomes deep blackish brown. A solution of iodide of potassium, to which a clear starch paste has been added, is, on being brought into contact with this gas, instantaneously coloured blue; while a strong solution of indigo in concentrated sulphuric acid, after having been gently heated, is very rapidly decolourised on coming into contact with this gas.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

The Proposed New Chair in the Andersonian Institution.—In our Students' Number we stated that Mr. Young's new chair of technical chemistry had been accepted

by Mr. V. H. Perkin; and, as the appointment had received the sanction of the trustees, we were justified in making the announcement. We are, however, now informed that the managers have asked the trustees to cancel the entire arrangement, and we accordingly hasten to notice this fact, especially as the present Professor of Chemistry in the Institution considers our announcement detrimental to his interests. We have received two pamphlets, one being Dr. Penny's remonstrance and appeal against the appointment of an additional Professor of Chemistry, and the other Dr. Adams's reasons of protest; from these we gather that, as Dr. Penny has always instructed his pupils in technical chemistry, and as his income is derived from class-teaching, the new chair would greatly interfere with his interests. Dr. Penny has expressed his willingness to consider any arrangement for carrying out Mr. Young's intentions, provided his titles, rights, &c., are preserved; or, for the actual progress of the Institution, he is willing to vacate his chair on condition of receiving a reasonable compensation for his apparatus and the loss he would sustain. We have no doubt that Mr. Young will adopt some means of carrying out his munificent endowment, without that injury to present interests which it would certainly cause if the original scheme were to be adopted without considerable modifications.

Irrespirable Air of the Wine-Must Fermenting Tubs.—M. Saintpierre.—It is a well-known fact that the four Departments of the South of France, named l'Hérault du Gard, l'Aude, and Pyrénées-Orientales, produce, year after year, about 12,000,000 hectolitres (every hectolitre is rather m e than 22 gallons) of wine; every hectolitre of must gives off an average 2500 litres of carbonic acid gas, and, since the size of the fermenting tubs is such that each one contains with ease 400 hectolitres of liquid, one may readily imagine what a quantity of carbonic acid gas there will be disengaged, considering that, during the short space of from 2 to 3 weeks, from 500 to 1000 hectolitres of must are ready for fermentation in confined localities, generally of no more cubic capacity than 1000 cubic metres (rather more than 35.600 cubic feet). The gas given off during the fermentation has a rather high temperature, and is, moreover, charged with the vapours of various ethers and alcohols, simultaneously the products of the fermentation. Even to those accustomed to this sort of atmosphere its effect upon the system is very marked. Quicklime is very commonly placed in the cellars wherein the fermenting tubs are placed, and a good ventilation kept up. The author of this paper has found, however, that nitrogen is among the products of fermentation; he states that, in 1868, he found that the atmosphere of a large tub could not support the combustion of a candle, although the empty tub (the must and dregs had been removed from it for fully 24 hours before his visit) contained a large quantity of quicklime, and no indication was found of carbonic acid. On analysis of the air contained in this tub it proved to consist, in 100 parts, of:—Oxygen, 11·85; and nitrogen, 88·15. Only the best possible ventilation and plentiful use of lime and lime-water can make cellars wherein these fermenting tubs are placed fit for work-people.—*Journal de Pharmacie et Chimie.*

International Exhibition of Amsterdam.—Professor Pepper is now giving an instructive lecture at the Royal Polytechnic on the "Tentoonstelling." While speaking highly of the inhabitants, the lecturer refers at length to their industrial pursuits, and illustrates the lecture with enlarged views of the Exhibition as well as some curious costumes worn by the Netherlanders. The lecture occupies less than an hour in delivery, and gives a very clear idea of the country and its people.

Glycoblastol.—Under this name there has been brought out at Vienna a cosmetic to be applied to the hair. It is simply made up of glycerine which has been digested with the rind of capsicum and perfumed with patchouli. As glycerine is by no means a proper substance to be applied to hair, this cosmetic, which is sold at an exorbitant price, ought not to be employed.

Fluid Glue.—To 1 kilo of best glue dissolved, by the aid of a gentle heat, in 1 litre of water, 0·2 kilo. of nitric acid at 36° Beaumé (sp. gr. 1·334). After the at first rather strong evolution of nitrous acid vapours has ceased, the liquid is cooled and fit for use; a better product is obtained when dry clear glue (so-called gelatine) is treated and dissolved on a water-bath in its own weight of strong vinegar, one-fourth of its weight of alcohol, and a very small quantity of alum.

Elastic Glue.—Glue is dissolved in water by the aid of a water-bath, and evaporated until quite a thick fluid is obtained; to this a quantity of concentrated glycerine is added, equal in weight to the quantity of glue taken, and the evaporation is continued, while the mixture is frequently stirred, in order to drive off the remaining water; the mass is then run upon clean marble slabs, and cooled. This material is usefully applied for the inking-rollers of printers, and various other purposes.—*Deutsche Industrieblätter.*

NOTES AND QUERIES.

Estimating Ammonia.—In answer to the query of "A. Z." (CHEMICAL NEWS, vol. xx., p. 156) (*Am. Rep., Nov.*, 1869, *page* 316), respecting a ready commercial method of estimating the percentage of ammonia in sulphate of ammonium, I beg to say that the readiest and most reliable method for this purpose is as follows:—Place a known weight of the salt in a flask fitted with cork and bent tube with bulb (the bend and the bulb are to prevent spirting and carrying over of any caustic liquor by the steam), and, having dissolved in a small quantity of water, distil, with a strong solution of caustic soda, potash, or milk of lime, into a beaker containing a known volume of a titrated solution of hydrochloric acid. The liquid in the flask is boiled till two-thirds are distilled over into the acid, which must be kept cool by immersing the beaker in a vessel of cold water, and keeping a stream of water circulating through the latter during the experiment. The tube is now carefully withdrawn from the acid, still keeping the lamp under the flask, or the contents of the beaker would immediately be sucked back. Just as the tube emerges from the liquid, it is well rinsed with the wash-bottle. The partially-neutralised solution in the beaker is washed out into a basin, tincture of cochineal added, and then the excess of hydrochloric acid is determined at once. In the cold, by means of a sodic carbonate solution of exactly equivalent strength to the hydrochloric acid. The volume of sodic carbonate solution subtracted from that of the hydrochloric acid equals the volume of acid solution required; and the HCl solution should, for the sake of rapidity of working, be so graduated that the number of volumes required should equal the percentage of NH_3 in the salt. If pyrites has been used in the manufacture of vitriol, the vitriol is contaminated with anhydrous persulphate of iron (as a white deposit, which di-appears on dilution), and also with a large quantity of arsenic: if, then, iron and a comparatively large quantity of arsenic be found to exist in a sample of vitriol, I think "A. Z." may take it for granted that pyrites has been used in this case. This method is applicable for the estimation of ammonia in any of its salts, providing that these be free from any organic nitrogenous matter. The caustic solutions (potash, soda, or lime-milk) should be well boiled previous to use, and allowed to get quite cold again: this is to free them from all traces of ammonia. In a subsequent communication, I will give the methods for the calculation and construction of volumetric solutions, from which the percentages may be immediately ascertained as being identical with the number of volumes of such volumetric solutions required.—WATSON SMITH, F.C.S., West Gorton, near Manchester, Sept. 27, 1869.

Carbonic Acid.—Can any of your readers give me some practical information respecting the manufacture of the above by Harrison Blair's process, viz., the passage of common or superheated steam over red-hot limestone enclosed in fire-clay retorts?—Coz.

Spectrum of Sirius.—In the hydrogen line, F, of the spectrum of Sirius, that line is not exactly coincident with the solar line, F. If, then, this deviation exists in that line, should not the like condition occur with respect to the lines of sodium, iron, &c., which I do not understand Mr. Huggins to state?—W. P.

Magic Lantern Light.—I require a powerful light to show to an audience the microscopic image enlarged upon a white sheet in a darkened room, and would take it kind if any of your readers could tell me—(1) Will the magnesium lamp do (the room is a comparatively small one); (2) whether is Solomon's or Larkin's powder-lamp best; and (3) where can I obtain or hear of Larkin's lamp (mentioned in the CHEMICAL NEWS, vol. xv., p. 323 (*Am. Rep., Aug.*, 1867, *page* 105)?—C. HUNTER.

Detection of Artificially-Coloured Red Wine.—Dr. Wittstein.—The author states that he was desirous to try whether the statement of M. Facen that peroxide of manganese has the property of decolorising naturally red-coloured wine, but leaving the colour of artificially red-coloured wines untouched when, after having been simply for some time in contact with the peroxide, it is filtered off from that material

again. The author had some genuine good red wine, the produce of his own vineyard, and also experimented upon some samples obtained from wholesale houses; and he found that, after treatment with peroxide of manganese, all these samples lost their red colour; and, according to Facen's statement, there might be assumed that none of these samples of wine were artificially coloured. The author then added to a genuine red wine about 1-25th part of its weight of mallow flowers (Flores Malvæ arboreæ), which are largely used for colouring wine; and, at the same time, the author repeated this experiment with a very faintly straw-yellow-coloured white wine, obtaining thus beautifully red-coloured wines. On shaking these up with peroxide of manganese, the artificially-coloured samples were, however, found as readily decoloured after filtration as the genuine red wines had been; therefore M. Facen's test does not hold good.—*Polytechnisches Centralblatt.*

Magnesium Lamps.—(Reply to "C. Hunter.")—Messrs. Johnson and Matthey, of Hatton Garden, can give information about, and probably supply, every kind of magnesium lamp.

Magnesium Lamps.—(Reply to "C. Hunter.")—Larkin's magnesium powder lamp may be obtained of Mottershead and Co., Manchester.

Halliday's Machines.—Can any of your readers inform me where to find the makers of "Halliday's machines" for treating sawdust in the manufacture of pyroligneous acid and acetate of lime, and also the makers of the best wood-distilling apparatus.—A. W. N.

Carbonic Acid.—(Reply to CO_2).—Why not rather make carbonic acid by Ozouf's process, that is, by forcing air through previously strongly-ignited charcoal, contained in a properly constructed stove or furnace? It is true the gas thus obtained is contaminated with carbonic oxide and a very small quantity of combustible gases. The process alluded to by you is patented, I think, but it is certainly not a cheap process, and, if your limestone is tolerably pure, you had better dissolve it in either hydrochloric or sulphuric acids (both diluted with water of course), and collect the gas thus set free.—J. A.

Tungstate of Soda, &c.—Can any of your readers give us the names of manufacturers of tungstate of soda and tungstate of chrome?—J. C.

Bichromate of Potash.—Can any of your numerous readers inform me if bichromate of potash is manufactured anywhere else except in Scotland?—Bichrome, Glasgow, October 27, 1869.

Detection of Prussian Blue in Black Ink.—Can any of your readers kindly inform me how to detect Prussian blue in black ink, that is, if any has been used to give it a blue colour; and also if there is a means of telling when there is logwood used in the preparation, or galls.—J. Kaye.

Footpaths.—I wish to lay down a cheap footpath. Can any of your readers inform me of a compound that will harden and not be affected by the weather? I was thinking of using a mixture of tar, pitch, sand, and gravel. What can I add to prevent it softening with the heat of the sun? If there is nothing cheaper, will cement do it? and if so what proportion must be used? Many of the streets in Paris are made with a compound put down in the form of powder, which after having been rolled with heavy rollers, becomes very hard, and forms a smooth and durable road. What is the mixture used?—Roadway.

Purification of Glycerine.—M. Kunath.—The glycerine used largely in those parts of Central Europe where the winters are severe for the filling of wet gas-meters has to be purified again, and concentrated after it has been in use for some time. For this purpose the impure glycerine is poured in a large vessel, and, upon every hundredweight of glycerine, 10 lbs. of iron-turnings are added; the whole mass is thoroughly stirred up, and this stirring repeated for some hours every day for a fortnight. After that period, the mixture is left quietly standing for some weeks, when the clear liquid is withdrawn from the sediment by means of a syphon, concentrated by evaporation, and again used in the gas-meters. The iron-turnings act mechanically as well as chemically: sulphuret of iron is formed, and the formation of this substance aids the precipitation of tarry matters.—*Dresdener Gewerbe Vereins Zeitung.*

Rendering and Bleaching Tallow.—Will any of your practical correspondents kindly give me the best and cheapest methods of rendering and bleaching tallow from rough fat, and how much per cent of tallow should be realised from rough fat rendered by the aid of sulphuric acid (say about 1 per cent of acid); or is that quantity of acid too much, as I find a great variation in the quantity obtained from present results; the quantity of rough fat rendered at each operation is about 3 tons. Is bleaching with black oxide of manganese and sulphuric acid considered the best, or a good method? as I find, in practice, it gives a yellow tinge—occasionally. What may be the cause? as I cannot get the tallow as white as it ought to be; it is more like beef tallow, although it is rendered from a mixture of beef and mutton fat. What substance can be used to precipitate impurities arising from rendering and bleaching when the process of washing is going on? Also, is there any method that can be used to prevent tallow *seeding* (a term generally used in the trade, which denotes the separation of the oily portion from the solid parts), besides continual agitation, until sufficiently cold to be packed?—A Tallow Melter.

Bleaching Syrups.—Can some of your readers give me the following information:—What will bleach syrups (common sugar-house syrup) without expensive apparatus? Will animal charcoal effect the object to any degree?—Andrew van Bibber, Cincinnati, October 14, 1869.

Rendering and Bleaching Tallow.—(Reply to "A Tallow Melter.") This correspondent is referred to Richardson's, Knapp's, and Watts's work on "Chemical Technology;" to Chevreul's work on Fats; and to Wagner's "Lehrbuch der Chemischen Technologie." There is a French publication on the subject in the useful series known as the "Encyclopédie Roret," published at Paris.

Standard Verification.—Having to deal with 1-100ths of an inch, and having a friend who has to deal with 1-10,000ths of an inch, and finding a deplorable ignorance among the skilled artisans of London and an awful discrepancy with expensive gauges by Holtzapffel's, Elliott, and others, can any correspondent guide me to any system of standard verification? Outside the Greenwich Observatory may be seen a standard of feet, inches, and moderate subdivisions. Is there any inner department for finer minutiæ available for the public?—S. E. P.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Enquirer.—We do not know if Professor Jellet's paper has been published or not.

A Constant Subscriber.—We know of no book treating on the proximate analysis of bodies only, but it is treated of in Watts's "Dictionary" under the word "analysis."

A. B. C.—(1) A new work on Dyeing is in the press; (2) Reimann's work on Aniline, price 10s. 10d., post free from our office; (3) Apply to Professor Calvert, at the Royal Institution, Manchester; (4) Animal mordants will fasten aniline dyes on cotton.

J. Cox.—The subject of your query has already been fully discussed in these columns.

W. H. Hindmarsh.—We know of no analytical practice for disposal just now, or of a partnership in chemical works. By repeating the advertisement, you would probably hear of one. A Mr. G. Green, of 5, Sebbon Street, Islington, has written to us for your address, as he wishes to have his certificate returned.

W. R.—Chloride of iron can only be economically prepared on the large scale at chemical works, where hydrochloric acid can be had at a mere nominal cost. Your other questions can be better answered by a few practical experiments, than by written descriptions. The last of Dr. Angus Smith's articles, "On the Examination of Water for Organic Matter," appeared in No. 510 (*Am. Repr., Nov.*, 1869, *page* 268).

Biggs, Holland, and Biggs.—We do not know the address of MM. Græbe and Liebermann, but a letter to the care of the publishers of the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin* will probably reach them.

Ferrum.—Send us sample, with full particulars, as we know of several who use it.

Amatta.—You will find particulars for making sympathetic ink in Cooley's "Cyclopædia of Practical Receipts."

A Trustee.—It will be necessary for you to send your name and address before we insert your query respecting the Andersonian Institution.

E. N.—Apply to Messrs. Baillière, Regent Street, for the foreign journals you require.

F. Cox.—You will find information on the Uranium Process for Estimating Phosphoric Acid in Nos. 430 and 432 (*Am. Rep., April and May*, 1868).

Ferrum.—Please forward your address.

Metallurgist.—(1) The latest and most complete treatise on Metallurgy is the English adaptation of Kerl, by Crookes and Rohrig; vol. i. 31s. 6d., and vol. ii., 30s., are published, and vol. iii. is in the press. (2) Mitchell's "Manual of Practical Assaying," edited by William Crookes; price 28s. These works can be obtained at our office. (3) A knowledge of your qualifications would be necessary to answer your other questions.

J. and E. Sturge.—Apply to Asher and Co., Foreign Booksellers, Bedford Street, Covent Garden.

E. U.—Comptes Rendus is published by Gauthier-Villars, Quai des Augustins 55, Paris.

J. Miller.—"Ancient and Modern Industry of the Chinese Empire" is published by Eugène Lacroix, Paris.

An Old Subscriber.—Reimann's "Handbook of Aniline," price 10s. 10d., post free, from our office.

Metallurgist.—You had better advertise in our columns for the situation you require.

W. U.—Mitchell's "Assaying" will answer your purpose best.

Books Received.—"Elements of Chemistry, Theoretical and Practical." By W. A. Miller, M.D., D.C.L., L.L.D., V.P.R.S., &c., fourth edition, with additions. Part III. Organic Chemistry. London: Longmans. "The Ship-Captain's Medical Guide." Compiled by Harry Leach. 3rd edition. London: Simpkin, Marshall, & Co.

"Exercises in Practical Chemistry," by A. G. V. Harcourt, F.R.S., and H. G. Madan, F.C.S. "Chemistry: General, Medical and Pharmaceutical, including the Chemistry of the British Pharmacopœia." By John Attfield, Ph.D. London: John Van Voorst. "A Pharmacopœia, including the Outlines of Materia Therapeutics, for the use of Practitioners and Students of Veterinary Medicine," by Richard Tuson, F.C.S., &c. London: John Churchill and Sons.

[English Edition, Vol. XX., No. 516, page 192; No. 517, page 204; No. 518, page 216; No. 519, page 228; No. 520, page 240; No. 514, page 168; No. 515, page 180.]

AMERICAN SUPPLEMENT.

New York, December, 1869.

Dangerous Kerosene.

SINCE our last issue went to press, we have noted an unusually large number of kerosene accidents, and as we believe that the public cannot be made to realize the enormity of the crime of selling dangerous burning oils, except by being compelled to read of the horrible results, we condense the following abstract. It must be borne in mind that *not one of these accidents would have occurred had the kerosene oil been of good quality.*

In New York, Sarah Kennedy, 63 years of age, and bedridden, was burned to death by the upsetting of a kerosene lamp at her bedside. A lamp exploded in Martin Leroy's bakery, setting fire to the premises. A kerosene lamp exploded at No. 40, Franklin street; damage trifling. A lamp exploded at 153 Attorney street, seriously burning a young lady. A demijohn of kerosene oil exploded in a store on Avenue A, causing damage to the amount of $300. Bloeuse Cachetsnyder, aged 48, died at 154 Stanton street, from burns caused by the explosion of a kerosene lamp. Two *liquid gas* lamps exploded in the reading-room of Reed's Hotel in Chatham street, severely burning John Ennis, one of the guests. An explosion of kerosene oil occurred in the store of Cornelius Finney, which, together with two adjoining stores, was considerably damaged.

In Brooklyn, Mrs. Sharkey, of 285 Myrtle avenue, was shockingly burned by the explosion of a lamp, which she was in the act of lighting. Edward and Peter Burns were severely burned by the explosion of a kerosene lamp at 15 Carroll street.

In Jersey City, Mrs. McPherson was badly burned by the explosion of a lamp which she let fall.

At South Amboy, Margaret Greenleaf was burned in a horrible manner by the explosion of a kerosene lamp. She survived her injuries twenty-four hours.

In Brooklyn, Ind., a young man who attempted to show his father how a new patent lamp operated, produced a grand explosion of lamp and oil-can, which set fire to the house, and caused damage to the amount of $7,000.

In Buffalo, a lamp exploded at a supper table, severely burning a little girl.

In Cleveland, Ohio, a young girl, who attempted to kindle a fire with kerosene, was fatally burned by the explosion of the can, and died, after lingering two days in great agony. In the same city a "non-explosive" lamp, filled with "non-explosive" oil, and capped with a "non-explosive burner," exploded.

In Troy, N.Y., a Mrs. Campbell was burned in the most shocking manner by the explosion of a lamp. Every part of her body, except the face, was exposed to the flames.

In Harwich, Mass., two little girls of six and four years respectively, were left with a kerosene lamp burning in the chamber in which they had been put to bed. Not long afterwards the house took fire and the children perished. As there were no fires burning in the house, there is every reason for believing that the kerosene lamp exploded while the children were asleep. The mother is now a maniac.

In Milwaukee, during a fencing scene at the Gaiety Theatre, one of the rapiers struck a kerosene lamp, which exploded, setting fire to the scenery. Before the audience had escaped from the building it was enveloped in flames. Fifteen or twenty persons were badly burned, besides several who were burned to death, or killed in the confusion which succeeded the accident.

At Spartansburg, Penn., a lady died from burns caused by the explosion of a kerosene lamp.

Such is the very imperfect record for November. *Some one person is responsible for each of these accidents —the person who sold the dangerous oil.* Many dealers do not know how dangerous their oils are; the wholesale dealers assure them that their particular brand is safe. These men must be educated—educated by the press—to a full appreciation of the importance of safe kerosene. They should procure an oil-tester, and learn to test the oil for themselves, and prosecute the wholesale dealers who supply them with a dangerous article. There are many dealers, however, wholesale and retail, who know well what they are selling, but who would sell their souls for a trifling gain. Such men must be reached by the strong arm of the law.

How can the sale of dangerous kerosene be prevented? is a question which I hear frequently asked. One writer says, punish the manufacturers and wholesale dealers. Another thinks it is very hard to compel the poor woman who keeps a china and lamp stall, and sells kerosene by the pint from a two-gallon can, to have her oil tested or to pay a fine of fifty dollars—her entire capital—if she is unfortunate enough to be supplied with dangerous kerosene by the pedler who calls twice a week. We say, make the penalty for selling dangerous kerosene as severe as possible—a heavy fine for the first offence, fine and imprisonment for the second. If it is found that small dealers cannot manage the business without serious danger to the public, then let them pursue some occupation less hazardous to their customers. Adopt a license system, and bring the sale of kerosene under municipal control at once, like that of gunpowder. We are satisfied that as soon as the public fully understands that *with safe oil no accidents occur*, the question of securing safe oil will be speedily settled.

In New York and Brooklyn the Board of Health and the Fire Commissioners are actively engaged in testing oils and in prosecuting the dealers, and we hope before long to record the conviction and punishment of some of them.

In Chicago the law against the sale of dangerous kerosene is about to be rigidly enforced.

Experiments have been recently made by agents of the Treasury Department, with regard to the quality of the oils used in the Western States, and we are informed that the present steamboat law is to be enforced to prevent the use or transportation of explosive or unsafe oils by river steamboats.

All this is very encouraging, but much remains to be done. We hope every writer for the press will say a good word for the cause, and that dangerous kerosene, which is now the rule, will soon become the exception.

Fire-Marshal BRACKETT reports:

Fires in New York during the year ending October 30th, 913; of which 98 were caused by Kerosene, Liquid Gas, and Gasolene; estimated damage caused by these 98 fires, $72,720. More than ten per cent. of the fires caused by kerosene, etc. How can we convey any adequate of the human suffering endured by the victims of the explosions.

The Explosion in Brooklyn.

On the evening of October 25th, an explosion occurred in Brooklyn, N.Y., at the Robbins' Wood Preserving Works. Martin Voorhees, of Princeton, N.J., was engaged in testing what he considered an improved apparatus for applying the Robbins process. Mr. Robbins' apparatus consists of a long iron cylinder, into which cars loaded with the wood to be treated are run. The ends of the cylinder are closed by heavy doors, securely fastened. From an adjoining still the vapors from heavy oil of coal-tar are driven over into the cylinder; and by the high temperature and the condensing vapors, the water of the wood is rapidly replaced by the oils rich in carbolic acid. Mr. Voorhees considered the separate still superfluous, and constructed a fire-box with a broad grate directly beneath his cylinder, which heated the entire length of the cylinder for a width of about two feet; the rest of the cylinder, which was about eight feet in diameter, being cold. Heavy oil of coal-tar was placed in the bottom of the cylinder to a depth of five or six inches, the cars loaded with wood were run in, the doors secured, and a fire kindled beneath the cylinder, about eight bushels of anthracite coal being ignited. After a time considerable water began to leak out around the joints of the doors at the ends of the cylinders; the couplings were then tightened. Just before the explosion the very sensitive pressure-gauge showed no pressure, but suddenly the doors were blown out, killing Mr. Voorhees and a laborer, and severely injuring a boy who was standing near. The roof was blown off, and the wooden structure which covered the cylinder was set on fire and destroyed. The violence of the explosion must have been great, as the doors were of cast and wrought iron, three-fourths of an inch thick. They were hung on massive hinges, and bolted all round their circumference to the flanges of the cylinder. It is not quite clear how the explosion was caused. That it was not due to a gradually-increasing pressure is shown by the fact that a moment before neither the pressure-gauge nor the safety-valve gave any indication of pressure. Two theories have been proposed to account for the sudden explosion: either it was due to the formation of an explosive mixture of air and hydrocarbon vapors, or to the sudden contact of a quantity of condensed water from the wood with the highly-heated heavy oil. Mr. Voorhees had provided means for intercepting the water which might condense on the cooler surface of the cylinder, by placing gutters of angle-iron on each side, about a foot above the surface of the oil, and running the entire length of the cylinder. These gutters could be emptied occasionally by means of cocks on the outside, but had not been attended to before the explosion occurred. Very probably the heavy oil boiled up and thus came in contact with the matter in the gutters. It should be distinctly understood that it was not the Robbins apparatus but the Voorhees apparatus which exploded.

On a New Tartrate of Iron.

BY DR. ISIDOR WALZ.

A solution of protoxide of iron to which tartaric acid has been added, remains colorless on the addition of ammonia, nor does a solution of sesquioxide of iron change its color materially under the same circumstances; but it is otherwise when both oxides are present in the same solution. In this case the addition of tartaric acid, and subsequently of ammonia, produces a beautiful green color when the oxides are present, in the proportion of their chemical equivalents, *e.g.*, in a solution of magnetic iron-ore; when the proportions are different, the color is either a dirty or yellowish-green, according to circumstances. This color is in all cases quite evanescent, passing to brown in the course of a few hours by oxidation, rendering it impossible to obtain the salt in solution in a dry state by evaporation or desiccation.

A solution of Fe_2Cl_6 was reduced by means of zinc, and when the reduction was complete one portion of it was immediately treated with a solution of tartaric acid and supersaturated with ammonia; the solution was colorless. The other portion was allowed to stand a short time, and on being treated in the same manner, showed a fine green color. A part of the ferrous oxide had consequently been *oxidized* to the ferric state.

On the other hand, a solution of Fe_2Cl_6 was precipitated with ammonia, the precipitate washed and dissolved in tartaric acid till the solution was of a deep-red color. A portion of this solution was supersaturated with ammonia, when it changed its color slightly to brown; the other portion was allowed to stand over night, and when ammonia was added to this, the green color appeared, showing that the ferric oxide had been partially *deoxidized*.

Concluding from this that the green-colored liquid was the ammoniacal solution of the tartrate of magnetic oxide of iron, I prepared a quantity of this oxide artificially, and brought it into a boiling solution of tartaric acid. The black, granular oxide was soon transformed into a pale-green impalpable paste, which dried on the filter to a coherent mass. (This mass, ground fine, would be well adapted for use as a water-color.) Both before and after drying it was soluble in ammonia, with a green color which passed rapidly into brown; and though I have not yet analyzed this powder, I have no doubt that it is the double tartrate of ferric and ferrous oxide, composed, apart from the water of hydration, analogously to the tartar emetic, viz.:

$$\overset{\text{VIII.}}{\overline{K_2Sb_2}},\ 2(C_4H_2O_7).$$

$$\overset{\text{VIII.}}{\overline{Fe_2}},\ 2(C_4H_2O_7).$$

Dualine.

Capt. Von Schelha, of the Prussian army, has recently brought to this country a specimen of the new explosive agent, which is proposed as a substitute for gunpowder, nitroglycerine, and dynamite. Dualine was invented by Lieut. Dittmer, of the Prussian artillery, who was for some years assistant director of the royal powder mills at Spandau, and afterwards director of Mr. Nobel's nitroglycerine factory.

We cannot give the composition of this new agent, as although it is patented in the United States, the inventor prefers to withhold the details of its manufacture for the present.

It is claimed that Dualine possesses all the advantages of nitroglycerine and dynamite, with none of their disadvantages.

Hot and cold, dry and damp weather have no effect upon it.

It does not pack.

It is not liable to spontaneous decomposition. Burns quietly in the open air, exploding only when tamped in a blast hole or in a torpedo.

It is not exploded by concussion, and may therefore be used in shells.

It evolves, on explosion, no disagreeable gases.

It costs less than nitroglycerine or dynamite, and relatively less than gunpowder.

We cannot vouch for all these statements from our own experience; but we handled Dualine; endeavored in vain to explode it by blows; and saw it burn quietly in a grate fire. If future experiments fully establish all that is claimed for this agent, and as we have full confidence in the statements of Capt. Von Scheliha, we have no doubt they will, Dualine will be a very important agent in the western mines.

The Saratoga Seltzer Spring.

This spring is situated about seventy-five feet south of the High Rock Spring, in the village of Saratoga. It was discovered many years ago, and from the fact that a barrel was sunk into the ground to serve as a reservoir for it, it was called the "Barrel Spring." It received but little attention, however, and was suffered gradually to fill up with earth and stones.

In 1865, the property on which the spring is situated having changed hands, an excavation was made to tube the spring. This excavation penetrated the following strata, down to the limestone rock:—

1. 5 feet Muck. The original soil of the swamp.
2. 4 " Calcareous tufa. A hard stony layer.
3. 21 " Blue clay.
4. 4 " Hard pan.
5. Limestone. "Calciferous lime rock."

The tufa, which must have been formed by the waters of the spring, and which consists of the same materials as the celebrated "High Rock" of the neighboring spring, gave the following results on analysis:—

Carbonate of lime	87·83
Carbonate of magnesia	1·76
Oxide of iron	1·71
Alumnia	3·38
Sulphate of lime	trace
Silica (soluble)	0·16
Sand and clay (insoluble)	2·96
Organic matter	1·09
Moisture	0·50
Undetermined	0·61
	100·00

The carbonates of lime and magnesia were evidently derived from the water of the spring, the other constituents chiefly from the soil. This layer of tufa is more or less porous, with numerous cavities, in some of which small stalactitic masses of nearly pure carbonate of lime occurred. Leaves, twigs, nuts, snail shells, etc., were occasionally seen in this bed. A wooden hopper, five feet high and six feet square at the rim, was placed over the opening from which the spring flowed, and was securely tamped with clay to prevent leakage and exclude surface water. To the hopper was attached a wooden tube twelve inches square and twenty-nine feet long, which raised the water to the level of the ground. Above this was placed a glass tube three feet high. The entire depth therefore of the tube is thirty-seven feet. The water flows over the rim of the glass tube, but the pressure of the column of water reduces the flow of the spring to a small fraction of what it was while the excavation was open. The flow of gas is abundant and constant, but every few minutes there is a momentary evolution of an extraordinary quantity. The appearance of this fountain, on a bright sunny day, is most beautiful; the bubbles of carbonic gas, as they rise through the water, appearing like struggling globules of mercury.

The temperature of the water is 50° F. The taste is acidulous and saline, and much milder than that of any of the other Saratoga Springs.

Its resemblance in flavor to the celebrated Selters, or Seltzer water of Germany, was noticed by all who were acquainted with that water, and it has consequently received the name Saratoga Seltzer Spring by common consent.

The following are the results of the analysis of this water, made by C. F. Chandler and Paul Schweitzer. An analysis of the German Seltzer water by Kastner is inserted for comparison. In one United States gallon of 231 cubic inches are contained:

	Saratoga Seltzer.	German Seltzer.
Chloride of sodium	234·291 grs.	132 673 grs.
Chloride of potassium	1·335	0·469
Bromide of sodium	0·630	0·001
Iodide of sodium	0·031	
Fluoride of calcium	trace	0·012
Bicarbonate of lithia ($LiO,HO,2CO_2$)	0·899	·005
Bicarbonate of soda	29·428	77 295
Bicarbonate of magnesia	40·339	22 354
Bicarbonate of lime	89·869	19 288
Bicarbonate of strontia	trace	0·083
Bicarbonate of baryta	trace	
Bicarbonate of iron	1·703	0·919
Bicarbonate of manganese		0·027
Biborate of soda	trace	
Phosphate of lime	trace	2·328
Alumina	0·374	trace
Silica	2·561	1·905
Organic matter	trace	
Total	402·017 grs.	259·576 grs.
Carbonic acid gas	324·08 cubic in.	228·736 cubic in.

From these analyses it appears that the Saratoga Seltzer contains a few substances not found in the German spring, and although these substances occur in very small quantities, they undoubtedly add to the value of the water.

Recent Chemical Patents.

Issued October 19, 1869.

95,882.—Manufacture and Preservation of Metals.—J. Corson, Washington, D. C.

95,931.—Process for Amalgamating Gold and Silver.—A. B. Paul, San Francisco, and J. L. Wood, Independence, Cal.

95,933.—Manufacture of Iron and Steel.—J. Player, Philadelphia, Pa.

95,939.—Preserving Dead Bodies.—G. W. Scollay, St. Louis, Mo.

95,941.—Manufacture of Illuminating Gas.—B. Silliman, New Haven, Conn.

95,970.—Composition for Cleaning Stone.—F. Baumann, Chicago, Ill.

96,029.—Distilling Whiskey, and Other Spirits.—J. S. Oliver and E. Harris, New York.

96,056.—Apparatus for Ageing Spirituous Liquors.—R. D. Turner, New York.

Issued October 26, 1869.

96,097.—Process of Obtaining Useful Oil from the Acid Residuum of Petroleum.—A. Farrar, Longwood, Mass.

96,132.—Mode of Producing Useful Articles from Collodion and its Compounds.—J. A. McClelland, Louisville, Ky.

96,148.—Compound for Making Water-Proof Paper.—C. S. Rauh, Boston, Mass.

96,155.—Machine for Bleaching Cane-juice.—E. Skelly, Plaquemine, La.

96,197.—Mode of Cleaning Gas Retorts.—C. A. Bush, New London, Conn.

96,201.—Distilling and Treating Alcoholic Spirits.—G. Clark, Buffalo, N. Y.

96,237.—Rubber Compound for Packing.—J. Johnson, Brooklyn, E. D., N. Y.

96,239.—Process of Reducing Wood and Woody Fibres for Paper Pulp.—V. E. Keegan, Boston Highlands, Mass.

96,241.—Method of Recovering Grease from Waste Soap Liquors.—W. Kœhler, Norwalk Conn.

96,242.—Coloring Material for Dyeing and Printing.—C. Lauth, Paris, France.

96,243.—Fuel for Metallurgic Purposes.—C. E. Lester, New York.

96,248.—Explosive Compound.—W. Mills, New York.

Issued November 2, 1869.

96,345.—Solid or Dry Extract of Bark for Tanning.—J. Pickles, Wigan, England.

96,365.—Making Tanning and Dyeing Extracts.—B. C. Tilghman, Philadelphia, Pa.

96,374.—Manufacture of Carbonate of Soda.—O. Wuth, Pittsburg, Pa.

96,409.—Process for Producing Carbon Pigments.—A. Farrar, Boston, Mass.

96,423.—Rendering Animal Fat.—H. E. Gotleb, New York.

96,524.—Process of Refining the Waste from German Silver and Other Metals.—F. Wilcox, Waterbury, Conn.

96,525.—Process of Utilizing the Waste formed in Cleaning Copper and Brass Goods.—F. Wilcox, Waterbury, Conn.

Issued November 9, 1869.

96,633.—Process and Apparatus for Converting Cast-Iron into Steel.—A. Thoma, New York.

96,640.—Distilling Alcoholic Liquors.—S. F. Van Choate, Boston, Mass.

96,661.—Process for Coloring Muslin, Paper, &c.—F. Beck, New York.

96,721.—Process for Purifying Pyroligneous and Acetic Acids.—C. C. Parsons, New York.

96,755.—Reducing Ores.—C. D. Williams and W. H. Nobles, Saint Paul, Minn.

Issued November 16, 1869.

96,790.—Process for Reducing Rebellious Ores of the Precious Metals.—A. L. Frick and J. B. LeClerc, San Francisco, Cal.

92,872.—Furnace and Process for Treating and Reducing Ores, &c.—V. W. Blanchard, Bridgport, Vt.

97,001.—Mode of Collecting and Storing Carbonic Acid for Extinguishing Fires.—E. Thayer, Worcester, Mass.

97,004.—Artificial Marble.—C. Volckmann, Columbus, Ohio.

97,007.—Compound Soap.—A. Warfield, Alexandria, Va.

97,017.—Process of Manufacturing Steel.—J. J. Johnston, Alleghany, Pa.

Reissues.

90,160, reissue 3,677.—Manufacture of Glue.—W. A. Fleck, Philadelphia, Pa.

86,835, reissue 3,688.—Process of Utilizing the Waste Products of Combustion for the Manufacture of White Lead, and for Other Purposes.—H. Hannen, Philadelphia, Pa.

NEW PUBLICATIONS.

THE AMERICAN JOURNAL OF SCIENCE AND ARTS for November contains the following articles specially interesting to chemists: 1. On Certain Compounds of Chromium and Iron, by J. H. H. Corbin. 2. Examination of a Supposed Hercynite, by C. A. Walle. 3. On the Proximate Composition of Several Varieties of American Maize, by W. O. Atwater, Ph.D. 4. On the Magnetite in the Mica of Pennsbury, Pa., by James D. Dana and G. J. Brush. 5. On the Probable Origin of Albertite and Allied Minerals, by S. P. Peckham.

MANUAL OF QUALITATIVE CHEMICAL ANALYSIS. By Prof. Charles W. Eliot and Prof. Frank H. Storer. 191 pp. D. Van Nostrand, New York. 1869.

A SHORT COURSE IN QUALITATIVE ANALYSIS (with the new notation). By Prof. J. M. Crafts. 131 pp., with tables. John Wiley & Son, New York. 1869.

AGRICULTURAL QUALITATIVE AND QUANTITATIVE CHEMICAL ANALYSIS. By Prof. G. C. Caldwell. 307 pp. Orange Judd & Co., New York. 1869.

ABSTRACT OF A PAPER ON ATOMIC MOTIONS read before the Chicago Meeting of the American Association for the Advancement of Science. By Prof. H. F. Walling. 16 pp. Salem, Mass.

CONTRIBUTIONS TO THE MINERALOGY OF NOVA SCOTIA. By Prof. How. 8 pp. From the *Phil. Mag.* for April, 1869.

DIE GLIEDERUNG DER EOZOISCHEN FORMATIONSGRUPPE NORD-AMERIKAS. Von Dr. H. Credner. 53 pp. Halle. 1869.

ON THE RELATION BETWEEN THE INTENSITY OF LIGHT PRODUCED FROM THE COMBUSTION OF ILLUMINATING GAS AND THE VOLUME OF GAS CONSUMED. By Prof. B. Silliman. Paper read at the Salem Meeting of the American Association for Advancement of Science, Aug. 1869. 8 pp. New Haven. 1869.

A LECTURE ON MEASURES AND WEIGHTS. By Prof. Sidney A. Norton. 21 pp. Cincinnati. 1869.

THE SURFACE GEOLOGY OF THE BASIN OF THE GREAT LAKES AND THE VALLEY OF THE MISSISSIPPI. By Prof. J. S. Newberry. 24 pp. Reprinted from the Annals of the New York Lyceum of Natural History. 1869.

NOTES ON THE GEOLOGY OF WESTERN TEXAS AND CHIHUAHUA. By James P. Kimball, Ph.D. 10 pp. Reprinted from the *American Journal of Science and Arts* for Nov., 1869.

THE PHYSICAL SURVEY OF VIRGINIA. By Prof. M. F. Maury. 100 pp., with Maps. Second Ed. D. Van Nostrand, New York. 1869.

FIRST ANNUAL REPORT UPON THE GEOLOGY AND MINERALOGY OF THE STATE OF NEW HAMPSHIRE. By Prof. C. H. Hitchcock, State Geologist. 36 pp. Manchester, N. H. 1869.

ANNUAL REPORT OF THE SURGEON-GENERAL OF THE UNITED STATES ARMY. By J. K. Barnes, Surgeon-General. 11 pp. Washington, D. C. 1869.

BREVITIES.

AMERICAN INSTITUTE LECTURES.—At the last meeting of the American Institute, the Committee on Scientific Lectures announced the following course for this winter:—

1. Friday, December 17, 1869. Battle-Fields of Science. By Andrew D. White, President of Cornell University.
2. Friday, December 24, 1869. How Animals Move. By Prof. E. S. Morse, of the Peabody Academy of Science.
3. Friday, December 31, 1869. The Correlation of Vital and Physical Forces. By Prof. G. F. Barker, of Yale College.
4. Friday, January 7, 1870. The Air and Restoration. By Prof. J. C. Draper, of the College of the City of New York.
5. Friday, January 14, 1870. The Connection of Natural Science and Mental Philosophy. By Prof. J. Bascom, of Williams College.
6. Friday, January 21, 1870. The Constitution of the Sun. By Dr. B. A. Gould, of Cambridge, Mass.
7. Friday, January 28, 1870. The Colorado Plateau—Its Cañons and Ruined Cities. By Prof. J. S. Newberry, of Columbia College School of Mines.

MANUFACTURE OF NICKEL.—The Nickel Works of Joseph Wharten, Camden, N. J., employ at the present time 50 men. The ore used at this establishment is procured from Chester County, and is said to be of a very superior quality. Nickel is a scarce metal, and always occurs in combination with other metals. When pure, it is of a fine white color resembling silver. It is rather softer than iron; its specific gravity when cast is 8.279; when hammered, 8.932. The cobalt ores are commonly employed in the extraction of nickel, and they are now treated by the method of Wohler to effect the separation of the two metals. The arsenic is expelled by roasting the powdered speiss or ore first by itself, next with charcoal powder till the garlic smell is no longer perceived. The residuum is mixed with three parts of sulphur and one of potash, melted in a crucible with a gentle heat, and the product being edulcorated with water, leaves a powder of metallic lustre, which is a sulphuret of nickel free from arsenic; while the arsenic associated with the sulphur and combined with the resulting sulphuret of potassium, remains dissolved. The sulphuret must be finally washed, dissolved in concentrated sulphuric acid, with the addition of a little nitric; the metal must be precipitated by a carbonated alkali, and the carbonate reduced with charcoal. The nickel made at the Camden Works is sold, or a portion of it, at the Mint in this city, and forms twelve per cent. of the new cent authorized by Congress in 1857.—*Philadelphia Ledger.*

STREET CLEANING BY THE BOARD OF HEALTH.—Dr. Elisha Harris, the Sanitary Superintendent of the Metropolitan District, which includes New York and Brooklyn, reports that there were cleaned under his direction, between the 14th of July and the 1st of Oct., an average of forty-five miles of street per week. The dirt was hoed and swept up, the gutters were cleaned, the hydrants were freely used for washing the streets and gutters, and disinfectants were used when necessary. Of heavy oil of coal-tar 2695 gallons were employed; of quicklime, 263 casks; of chloride of lime, 1952 pounds. The disinfectant now recommended for privies and cesspools is a mixture of sesquichloride of iron and carbolic acid. It is sold in New York under the name of the "Metropolitan Disinfecting Fluid."

A GRAND INTERNATIONAL EXHIBITION, or World's Fair, will be opened on the 1st of September, 1870, at Saragossa, the capital of Aragon, in Spain. Every advantage is offered to exhibitors—such as free entry, half rates for freight on the railroads, etc. For further particulars address Francisco de Carpi, Spanish Vice-Consul, No. 29 Broadway, New York.

DESTRUCTION OF A CABINET BY FIRE.—A destructive fire occurred at the Rochester University on the evening of Oct. 9th, by which the laboratory, workshop, and private mineralogical, zoological, and other cabinets of Prof. Henry Ward, as well as his great collection of plaster casts, moulds, models, etc. were destroyed. The large cabinets sold by Prof. Ward to the University a few years since were not injured.

A LIBERAL GIFT FOR SCIENTIFIC PURPOSES.—Mr. Orange Judd, the proprietor of the *American Agriculturist*, has given $50,000 to the Wesleyan University at Middletown, Conn., for the erection of a building for the department of natural science.

THE SCIENTIFIC CONGRESS OF FRANCE has just held its thirty-sixth session at Chartres, under the Presidency of M. de Caumont. The proceedings lasted eight days.

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